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**GUIDANCE MANUAL
FOR
HAZARDOUS WASTE
CATEGORIZATION AND
REVIEW PROGRAM**

JANUARY 1991



Ontario

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**GUIDANCE MANUAL FOR HAZARDOUS WASTE CATEGORIZATION
AND REVIEW PROGRAM**

**Report prepared by:
Waste Management Branch
Ontario Ministry of the Environment**

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Preamble

Regulation 309 of Ontario's Environmental Protection Act contains lists of hazardous industrial wastes, acute hazardous waste chemicals, and hazardous waste chemicals. There are provisions in the Act to continually update these lists. In other words, new wastes determined to be hazardous may be added to the lists, and site specific wastes may be reviewed and delisted from the initial generic listings, as being non-hazardous.

It is important to ensure that the categorization (listing) and review (delisting) decisions are based on uniform evaluations of consistent and comprehensive information submitted in the applications. The waste categorization and review program has been designed to provide proper control of wastes that could adversely affect the health and environment of Ontario. This program is explained in detail in two guidance manuals:

- Volume A - provides details on addition of new hazardous wastes to the lists;
- Volume B - provides details on the mechanism of review of specific non-hazardous wastes.

VOLUME A
GUIDANCE MANUAL
FOR CATEGORIZATION OF HAZARDOUS WASTES
IN REGULATION 309

AUGUST, 1989

ONTARIO
MINISTRY OF THE ENVIRONMENT
WASTE MANAGEMENT BRANCH

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1.0 INTRODUCTION

1.1 Purpose of this document

In order to ensure proper handling and disposal of wastes, Regulation 309 under the Environmental Protection Act (EPA) of the Ontario Ministry of the Environment (MOE), provides definitions of hazardous wastes, and details the requirements for generators, carriers and receivers with respect to waste registration and manifesting.

The classification of hazardous wastes is achieved by a listing/testing approach, whereby wastes are defined as hazardous either by being listed in a Schedule or by possessing specified characteristics normally determined by test protocols.

The Regulation allows for review and continual updating of the Schedules. New wastes judged to be hazardous are added to the lists, while specific wastes from a particular facility determined to be non-hazardous can be reviewed (or delisted) for that particular facility only.

The purpose of this document is to provide details of the categorization (listing) process. A companion volume describes the evaluation procedures for potential review (delisting) of specific non-hazardous wastes from the lists.

1.2 Categorization (Listing) of hazardous wastes

Regulation 309 uses two steps to classify wastes as hazardous:

- a) Testing of waste: using testing protocols defined in Regulation 309, the waste is tested for specific hazardous characteristics (i.e., ignitability, corrosivity, reactivity, leachate toxicity). A waste may also be defined as hazardous because it is regulated elsewhere (e.g. PCB waste in Regulation 11/82) or because of a specific property of concern (e.g. pathological waste, radioactive waste).
- b) Listing of streams/contaminants: a specific industrial waste stream or a specific contaminant may be listed in Schedules 1, 2 or 3 of Regulation 309 because the waste presents a potential hazard to human health or the environment.

The Ontario Ministry of the Environment (MOE) has listed nearly 100 industrial waste streams as hazardous industrial wastes (Reg. 309 Schedule 1) and nearly 700 commercial products as acute hazardous and hazardous waste chemicals (Reg. 309, Schedule 2, Parts A and B). These wastes are listed because they typically exhibit one or more of the hazardous characteristics or because they contain contaminants that are known to be toxic or otherwise hazardous to human health and the environment. The purpose of listing a waste as hazardous is to ensure that the generator will identify and manage the waste properly. Schedules 1 and 2 were derived initially (in 1985) from similar lists prepared by the United States Environmental Protection Agency (USEPA).

The Ministry provides an ongoing mechanism for adding hazardous wastes to the existing lists. A request for listing a waste as hazardous does not require extensive documentation. However, the industry, the type of waste, the contaminants of concern and the current waste management practices must be identified as much as possible by the initiator. The Waste Management Branch (WMB) will review the request and will prepare a listing document if necessary.

Members of the public, industry or government may initiate the listing process by directing a request for the examination of an unlisted waste (believed to be hazardous) to the Waste Management Branch of the MOE.

2.0 LISTING CRITERIA UNDER VARIOUS LEGISLATION

The process of listing a waste as hazardous is based on the evaluation of the potential hazard of the waste on human health or the environment. The listing evaluation relies on toxicity criteria and environmental behaviour criteria of the waste. Such criteria have been defined by a number of government agencies in their legislation or policy. In an effort to provide clarification to the reader, a summary of the criteria are presented for the following agencies:

- a) United States Environmental Protection Agency (USEPA), under the Resource Conservation and Recovery Act (RCRA);
- b) Environment Canada, Environment Protection Service (EPS), under a Federal/Provincial/Industrial Working Group on Criteria and Lists;

- c) Ontario Ministry of the Environment (MOE), under the Municipal/Industrial Strategy for Abatement (MISA) program: development of criteria for the Effluent Monitoring Priority Pollutants List (EMPPL). Although these criteria do not identify hazardous wastes, they, however, set priority on contaminants in a waste.

2.1 RCRA listing criteria

In summary, the RCRA listing criteria are defined in terms of:

- (a) Four hazardous characteristics (ignitability, corrosivity, reactivity and leachate toxicity);
- (b) Lethal toxicity (fatal to human);
- (c) Toxicity leading to serious irreversible illness (e.g. mutagenicity, teratogenicity, carcinogenicity);
- (d) Environmental behaviour of the contaminants, specifically in terms of their potential for:
 - Migration
 - Persistence
 - Bio-degradation/bio-accumulation
 - Historical and present waste management practices.

Details of the RCRA listing criteria are presented in Appendix A.

2.2 EPS hazardous waste criteria

An Environment Canada task force developed criteria for definition of hazardous wastes (EPS, 1985). Hazardous wastes are defined in terms of either dangerous goods listed in the Regulations under the Transportation of Dangerous Goods Act (TDGA) or criteria used in describing hazardous goods (Classes 1 to 9).

The TDGA criteria are similar to RCRA criteria for definition of hazardous characteristics (i.e. ignitability, corrosivity, reactivity and leachate toxicity). Additional classes in TDGA include infectious material (Class 6.2) and radioactive material (Class 7).

Long-term and other toxicity criteria (e.g. carcinogenicity) are also addressed in TDGA by either listing or assigning the waste to Class 9.3. Details of the EPS hazardous waste criteria are presented in Appendix A.

2.3 MISA's EMPPL Criteria

The Effluent Monitoring Priority Pollutants List (EMPPL) criteria have been developed for the identification and the hazard assessment of effluent contaminants in Ontario, as part of the MISA program. The EMPPL criteria are a subset of the MOE's Vector Scoring System, developed by the Priority List Working Group (MOE) and two consulting firms, and modified by the Hazardous Contaminants Co-ordination Branch (MOE). The Vector Scoring System contains a large number of parameters, some of which require extensive information about the contaminant. The System ensures that the toxicity and the environmental fate are systematically evaluated for any contaminant. In the EMPPL procedures, a contaminant is scored on a scale of 0 to 10, for the following parameters:

Environmental behaviour parameters:

- a) Environmental mobility
- b) Environmental persistence
- c) Bioaccumulation

Toxicity parameters:

- a) Acute lethality;
- b) Sub-lethality on non-mammalian animals;
- c) Phytotoxicity;
- d) Sub-lethality on mammals;
- e) Teratogenicity;
- f) Genotoxicity/mutagenicity;
- g) Carcinogenicity.

Environmental exposure:

An assessment of human and environmental exposure is conducted based on the potential presence of a chemical in Ontario municipal and industrial effluents.

3.0 LISTING CRITERIA UNDER REGULATION 309

3.1 Current Situation

The initial listing of hazardous wastes in the Schedules of Regulation 309 relied on the background research carried out and compiled by the U.S. EPA for its Resource Conservation and Recovery Act (RCRA), and is consistent with the Canadian Transportation of Dangerous Goods Act (TDGA).

While RCRA lists will continue to be monitored for any additions, such additions will be evaluated through the new MOE listing criteria and procedures outlined in this manual before being added to the Schedules of Regulation 309. Of course, based on the evaluations, the Minister may decide not to proceed with a particular listing.

The listing process described in this document involves the preparation of a listing background document for the new waste. The background document provides an extensive review of the data on toxicity of the contaminant(s) in question and fully considers the impact of the waste on health and the environment, prior to formulating a recommendation. As is required for documents supporting a cabinet submission, the economic impact of listing wastes is also examined during the preparation of the background document.

3.2 Listing Criteria

A waste can be listed in Regulation 309 if it contains contaminants in concentrations or quantities such that the waste is judged by the Ministry to be potentially hazardous to human health or the environment (which includes air, water, soil, and biota). The potential hazard is evaluated in terms of hazardous characteristics, environmental behaviour and toxicity criteria. These criteria represent the findings and conclusions of organizations and agencies identified in Section 2.0. These criteria represent the new approach of the Ministry regarding toxicity evaluation of wastes.

3.2.1 Hazardous Characteristics

One approach to identify hazardous wastes under Regulation 309 is to define them in terms of hazardous characteristics. Wastes are defined hazardous if they are:

- a) Ignitable (s.1.29)
- b) Corrosive (s.1.10)

- c) Reactive (s.1.51)
- d) Leachate toxic (s.1.37)

Hazardous wastes can also be defined in terms other than hazardous characteristics (i.e. pathological, PCB and severely toxic wastes).

A waste which exhibits a hazardous characteristic may also be listed. The purpose of listing a waste based on hazardous characteristics is to simplify its identification as hazardous in the industrial sector and to define acceptable waste management practices. The definitions of the hazardous characteristics are detailed in Appendix B.

3.2.2 Environmental Behaviour

This second category of criteria includes environmental mobility, persistence, bio-accumulation, and environmental exposure. The scoring system is detailed in Appendix B.

Environmental Mobility

Environmental mobility refers to migration of chemicals through environmental media (i.e. air, water, soil, sediment and biota). Inter-media transport can either be observed during field/lab studies or estimated in simple mathematical models.

Environmental Persistence

Environmental persistence refers to the tendency of a chemical to resist degradation under environmental stresses. Substances can be naturally subjected to a variety of degradation processes: oxidation, hydrolysis, photo-degradation and bio-degradation. Persistence is usually expressed as the half-life, which is the time required for one-half of the original amount of the substance to be degraded to a simpler chemical.

Values of half-life for chemical persistence may vary from seconds to thousands of years. Short half-lives (e.g. less than a few days) generally indicate a low level of concern (i.e. no significant accumulation in the environment). On the other hand, long half-lives (e.g. longer than several months) can lead to

substantial exposure or accumulation in the food chain.

Bio-accumulation

Bio-accumulation refers to the tendency for a substance to accumulate in biological systems, or tissues of organisms. The Bio-Concentration Factor (BCF) is frequently used as an index for bio-accumulation. In the case of aquatic organisms, the BCF is calculated as the ratio of the concentration (wet-weight basis) of a substance in the organism (or tissue) to the concentration of the substance in the water. For organic substances, values of the BCF range from about 1 to more than 1 million. BCF data for vertebrates are more difficult to evaluate and, consequently, are much less available.

Environmental Exposure

Environmental exposure refers to the evaluation of the possible pathways through which the waste contaminant(s) can reach a receptor and adversely affect human health and the environment. Environmental exposure assessment requires knowledge of waste generation parameters (quantity, concentration, frequency) and existing waste management practices. Scenarios of waste mismanagement can be drawn from this information. The worst case scenario is usually retained in the exposure assessment.

3.2.3 Toxicity Parameters

Acute Lethality

Acute lethality refers to the rapid lethality of a chemical to terrestrial and aquatic animals.

Sublethal Effect, Plants

Sublethal phytotoxicity refers to sublethal (injurious) effects of chemicals on plants. Sublethal effects vary widely depending on the chemicals. The significance of the injury may relate to appearance, growth or yield, and longevity. These toxic effects are generally assayed in laboratories.

Sublethal Effects, Mammals

Sublethal mammalian toxicity refers to the potential long-term effects of chemicals on mammals, including humans as a priority, and are restricted to sublethal systemic effects, which do not include carcinogenic, mutagenic or teratogenic effects.

Sublethal Effects, Non-Mammals

Sublethal non-mammalian toxicity refers to the potential effects in non-mammalian species, both aquatic and terrestrial, of long-term exposure to chemicals. Toxicity is evaluated in terms of median effective concentration (EC_{50}), maximum acceptable toxicant concentration (MATC) or no-observable adverse-effect concentration (NOAEC). These terms are defined in Appendix II.

Teratogenicity

Teratogenicity describes the potential of chemicals to cause non-hereditary congenital malformations (birth defects) in mammalian offspring. Such effects are usually irreversible.

Mutagenicity

Mutagenicity or genotoxicity refers to the ability of chemicals to cause permanent alteration of the genetic material within living cells.

Carcinogenicity

Carcinogenicity describes the potential of chemicals to cause cancer. Some biological, physical and chemical agents can cause or promote cancer.

3.3 Application of Listing Criteria

The listing criteria, outlined in Section 3.2 and detailed in Appendix II, are applied to each contaminant found in the waste. The toxicity of a mixture of contaminants found in the waste must be assessed, experimentally or mathematically, before a decision can be taken regarding the listing of such a waste.

Testing for hazardous characteristics is the first and simplest step. If the waste can be classified as hazardous based on hazardous characteristics, there may be enough justification to list the waste, especially so if the environmental exposure is of concern.

As a second step, the environmental behaviour and toxicity parameters are applied to the contaminant(s) of the waste, using an evaluation method derived from the Vector Scoring System. The objective of the Vector Scoring System (which was developed by a consultant and MOE) is to systematically evaluate the environmental fate and toxicity of a contaminant. Each environmental behaviour and toxicity parameter is scored on a scale of 0 to 10 (10 indicating the highest level of concern).

To simplify the evaluation process, a screening process has been established. The Ministry has set, for each parameter, a concern scoring level which represents the current thinking on severity of affect or potential hazard in an environmental content (see Table 1). These levels are similar to EMPPL levels (set by MISA for effluent monitoring), except for exposure assessment and chronic toxicity (sublethal effects), where pathways and long term exposure of contaminants are of more concern in waste management. If the score of any of the parameters equals or exceeds the respective concern level, the waste is selected by the screening system to be assessed in more detail.

In the detailed assessment of the waste, the MOE staff conducts a toxicity assessment using toxicity scores and an exposure assessment using environmental behaviour scores. Various MOE standards may be used for comparison and, where needed, research may be carried out to develop the necessary standards. The exposure assessment will help identify the pathways and the attenuation of the contaminants migrating from the waste to the receptor. The toxicity assessment will evaluate the risk levels of adverse effects on health and the environment.

For situations where the waste contains numerous contaminants, the combined toxicity must be assessed. Toxicity tests may be conducted on a representative waste sample. However, this approach may be costly and time consuming. Unless synergistic effects of the contaminants are documented, the combined acute lethality can be evaluated by using the following rule:

- (a) if any one of the contaminants, present in the waste, is selected by the screening system by reason of mutagenicity or carcinogenicity, the waste may be listed. These types of toxicity do not have a threshold value that links the concentration to the effect.
- (b) if any one of the contaminants present in the waste is not selected for listing based on the parameters included in (a) above, the waste may still be selected by the screening system based on acute lethality. The lethal level (LD₅₀ or LC₅₀) of the contaminant in the waste is calculated as follows:

$$\text{LD}_{50} \text{ (contaminant in waste)} = \frac{\text{LD}_{50} \text{ (contaminant)} \times 100}{\text{Percent of total contaminants by weight}}$$

- (c) if the toxicity of all contaminants in the waste are below concern levels, the combined toxicity must be calculated, using one of the following information (if available) in order of priority:
 - 1) Toxicity data on the precise mixture of the contaminants found in the waste;
 - 2) Toxicity data of similar contaminant mixture:

"similar contaminant mixture" refers to a mixture having the same contaminants but in slightly different ratios, or having several common contaminants, but lacking one or more components, or having one or more additional contaminants. The determination of sufficient similarity must be made on a case-by-case basis;
 - 3) Toxicity data of contaminants with quantified interactions:

synergistic or antagonistic interaction between certain contaminants of the waste may be documented and quantified. If enough documentation on enough contaminants of the waste are available, the toxicity of the mixture may be assessed;
 - 4) Toxicity data of contaminants with additivity rules. These rules will be specific to individual waste listing cases and will be derived from current findings on toxicity additivity.

TABLE 1
CONCERN LEVELS FOR TOXICITY SCORING

<u>ENVIRONMENTAL BEHAVIOUR PARAMETERS</u>	<u>CONCERN LEVEL (a)</u>
1. Environmental Mobility	≥7
2. Environmental Persistence	≥7
3. Bioaccumulation	≥7
4. Environmental Exposure	≥7
 <u>TOXICITY PARAMETERS</u>	
5. Acute Lethality	≥6
6. Sublethal effects, plants	≥4
7. Sublethal effects, mammals	≥4
8. Sublethal effects, non-mammals	≥4
9. Teratogenicity	≥2
10. Mutagenicity	≥6
11. Carcinogenicity	≥2

(a) Details of the Vector Scoring System can be found in Appendix II.

4.0 LISTING PROCESS

4.1 Request for Hazardous Waste Listing

Requests for the listing of wastes as hazardous would normally come from regulatory agencies for health and environment, concerned organizations and the public at large. More specifically, the following organizations within the Ministry of the Environment may be involved:

- a) Hazardous Waste Listing Unit of the Waste Management Branch;
- b) Hazardous Waste Review Committee (HWRC);
- c) Waste Management Branch (WMB) Staff involved in hazardous waste management planning and policy development;
- d) Water Resources Branch (WRB) (including the MISA program);
- e) Air Resources Branch (ARB);
- f) Hazardous Contaminants Co-ordination Branch (HCCB);
- g) Other MOE task forces or committees involved in contaminant evaluation and classification (e.g., Priority Substances Advisory Committee, Regulation 309 Steering Committee, Regulation 309 Implementation Committee, etc.); and
- h) Regional staff.

Outside MOE, other organizations, such as noted below, involved in health and environment protection, may identify contaminants to be considered for listing:

- a) Hazardous Waste Advisory Committee (HWAC);
- b) Provincial, interprovincial and federal task forces or committees (e.g. Waste Committee, TDG Working Group of CCREM); and
- c) Public interest groups and associations.

4.2 Procedures

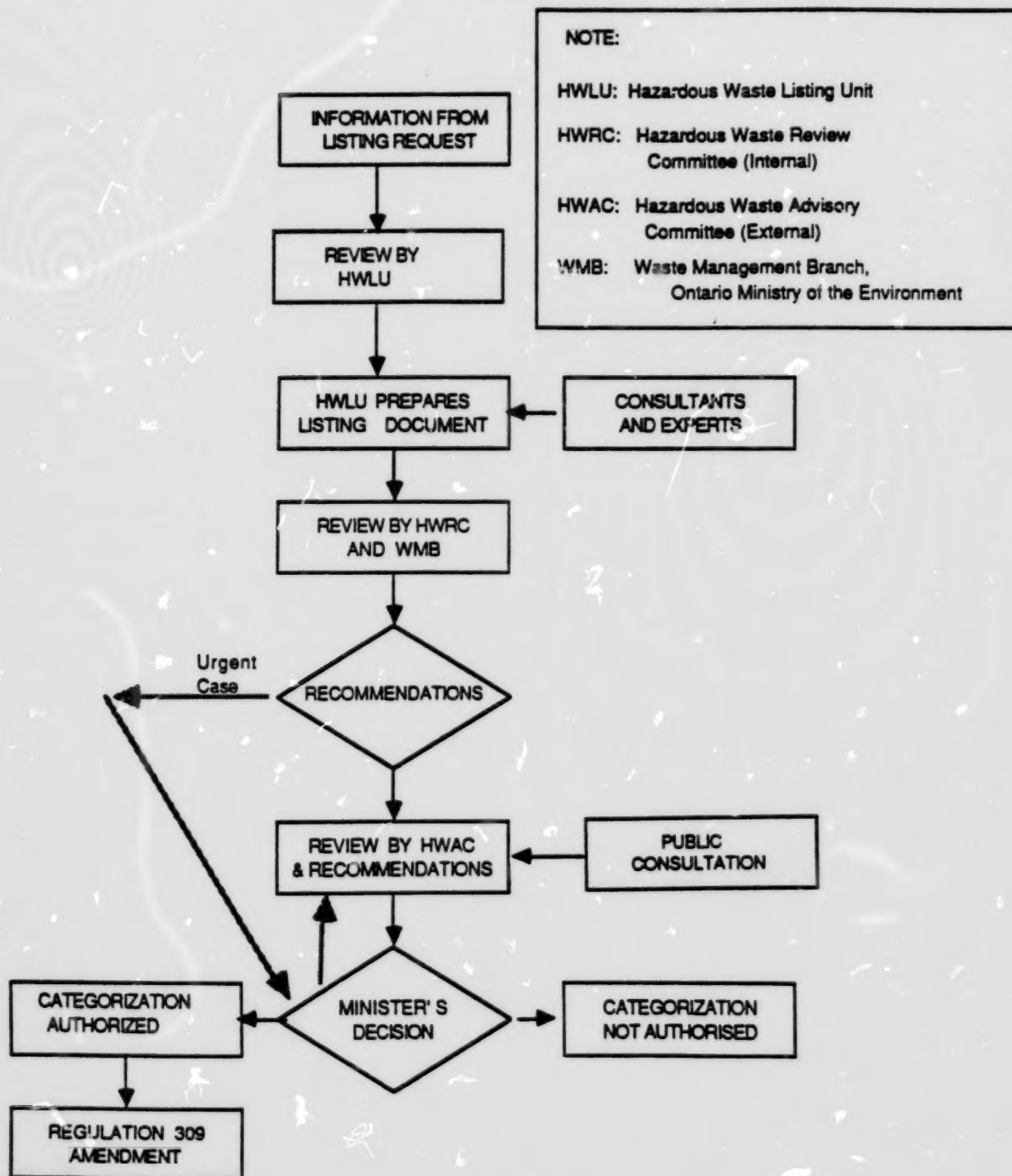
Figure 1 illustrates the procedures for categorization (listing) hazardous waste in Regulation 309.

A request for listing may come from one of the parties identified in section 4.1. The Hazardous Waste Listing Unit (HWLU) reviews the information and may require, if needed, clarification from the requesting party.

The HWLU prepares a listing document which will identify the nature of the waste, the industrial sector generating the waste, the toxicity levels and proper waste management practices. The details of the nature and format of the listing document are presented in the following sections of this report. In the preparation of the listing document, assistance from environmental consultants, expert toxicologists or physicians may be required. Such experts may be found from senior staff of other Branches of MOE or other ministries (Labour, Health, etc.). Consultations with the industrial sector in question and evaluation of the economic impact of the actions may also be initiated at this stage. The categorization (listing) document is examined by the (internal) Hazardous Waste Review Committee (HWRC), consisting of members of each branch of MOE and a member from the Ministry of Labour. The recommendations of this Committee are provided to the Director, Waste Management Branch, who forwards the document and the recommendations to the Minister's (external) Hazardous Waste Advisory Committee (HWAC). This Committee is charged with the responsibility of evaluating the recommendations of MOE, and ensuring that adequate public consultation takes place on this issue. The HWAC submits its recommendations to the Minister of the Environment. If the Minister agrees with a listing (categorization) document and decides to authorize a listing in this Schedules of Regulation 309, necessary steps are taken to achieve this Amendment.

In urgent cases, the information can be forwarded from the WMB directly to the Minister, with a copy to HWAC.

**Figure 1: HAZARDOUS WASTE CATEGORIZATION
(LISTING) PROCESS**



5.0 PREPARATION OF LISTING DOCUMENT

5.1 Objective

The main objective of the listing document is to provide the technical basis for listing a waste under Regulation 309.

This requires that a number of issues be addressed:

- a) Identification and detailed information about the process and the industrial sector responsible for the generation of the waste in question (including the quantity of waste generated);
- b) Determination of the waste constituents, their concentration and their toxic effect levels;
- c) Discussion of the benefits of listing this waste, compared to the existing waste management practices; and
- d) Impact on the environment and/or health, if waste not listed.

The listing document is later used by MOE staff for reference in the interpretation and application of Regulation 309. The same document can also be used by either the waste generators or Ministry staff during a request for delisting of specific waste streams not identified during the listing process.

5.2 Content of Listing Document

A typical document will have, but may not be limited to, the following table of contents:

- 1. *Summary of the basis for listing*
- 2. *Description of industrial sector*
 - 2.1 *Process description*
 - 2.2 *Waste generation and composition*
- 3. *Waste management practices*
- 4. *Hazardous properties of the waste*
- 5. *References*
- 6. *Appendices (optional)*

5.2.1 Summary of basis of listing

The purpose of the summary is to introduce the reader to the particular industrial sectors affected by the listing. Conclusions (i.e. the basis for listing) are summarized by indicating the human health and environmental concerns associated with the waste and the existing waste management practices.

5.2.2 Description of industrial sector(s)

A comprehensive review of the industrial sector identifies the general process of waste generation. Details of the production processes must be included in the description if they are related to the generation of the waste. Process and other variations will be taken into account in the documentation of the waste composition.

When possible, a comparison with similar industrial sectors, in other jurisdictions should be included. This information would be particularly useful in understanding industrial processes from which wastes are imported into Ontario.

5.2.3 Waste management practices

Existing waste management practices prevailing in the affected industrial sector(s) are reviewed in this section. In the absence of substantial and reliable information, the review may require the assistance of consultants under contract.

Waste management practices include quantity of waste generated, storage methods on site, means of transportation, and disposal methods. Detailed waste management incidents or problems should be included in the document to illustrate the need for listing a particular waste, because of the existing or anticipated impact on environment/health.

5.2.4 Hazardous properties of waste

The hazardous properties of a typical waste from the industrial sector are assessed by using the criteria identified in section 3.2 of this document.

In more complex cases, an expert toxicologist may be contracted, generally by the Ministry, to prepare a study on health effects and risk assessment.

5.2.5 References

Any statements referring to studies or reports must be referenced in a manner similar to the one used in scientific papers or publications. This approach will allow for thorough review of the listing document by other scientific staff and committee members.

5.2.6 Appendices

Information, too lengthy to be incorporated in the main text, is included as appendices. This information is often necessary to support statements in the listing document.

APPENDIX I: LISTING CRITERIA UNDER OTHER LEGISLATIONS

INTRODUCTION

For the purpose of clarity, a brief review of the existing listing criteria is presented in the following section.

I-1 RCRA listing criteria

Under this U.S. Public law "Resource Conservation and Recovery Act" (RCRA), a solid waste is listed as a hazardous waste if it meets one of the following criteria:

1. It exhibits any of the following hazardous characteristics: ignitability, corrosivity, reactivity, and EP (extraction procedure) toxicity;
2. It has been found to be fatal to humans in low doses, or in the absence of data on human toxicity, it has been shown in studies to have;
 - a) An oral LD50 toxicity (rat) of less than 50 mg/Kg; or
 - b) An inhalation LC50 toxicity (rat) of less than 2 mg/l (2,000 mg/m³); or
 - c) A dermal LD50 toxicity (rabbit) of less than 200 mg/Kg; oris otherwise capable of causing, or significantly contributing to, an increase in serious irreversible or incapacitating reversible, illness (designated Acute Hazardous Waste);
3. It contains any of the toxic constituents listed in Appendix VIII of RCRA, unless it is concluded that the waste is not capable of posing a substantial hazard to human health or the environment when improperly managed (i.e. treated, stored, transported or disposed of), after considering any of the following factors:
 - a) Nature of the toxicity of the contaminant;
 - b) Concentration of contaminant in the waste;
 - c) Potential migration of the contaminant to the environment under improper management scenarios;

- d) Persistence of the contaminant;
- e) Potential of degradation into non-harmful constituents;
- f) Degree of bioaccumulations in ecosystems;
- g) Plausible improper management scenarios;
- h) Quantities of waste generated at sites, on regional/provincial/national basis;
- i) Nature and severity of historical damage to human health and environment due to improper management of contaminants;
- j) Action taken by other governmental agencies or regulatory programs based on health/environment hazards from the contaminant; and
- k) Other appropriate factors.

I-2 EPS hazardous waste criteria

A Federal/Provincial/Industry Task Force agreed on a general working definition for hazardous waste (EPS, 1985):

"HAZARDOUS WASTE: wastes which due to their nature and quantity are potentially hazardous to human health and/or the environment and which require special disposal techniques to eliminate or reduce the hazard."

Two main qualitative criteria were used by the Task Force to define "hazardous":

- a) **REACTIVITY:** tendency of a waste to react or undergo change under specified chemical or physical conditions (i.e. properties such as explosive, ignitable, corrosive, interactive, bio-accumulative and radioactive).
- b) **TOXICITY:** potential for a waste to cause damage to the structure or disturb the functions of an organism exposed to that waste (lethality, carcinogenicity, pathogenicity and genotoxicity etc.).

The Task Force further adopted the following criteria for classification of hazardous waste:

- a) All substances currently listed as dangerous goods in the Regulations of the Transportation of

Dangerous Goods Act (TDGA) and the list of generic and source-specific waste streams (listed in U.S. Federal Register, May 19 and July 16, 1980) are considered listed substances/waste streams under TDG Regulations (DOT, 1984);

- b) Criteria used in describing hazardous properties for TDG classes 1 to 8 may be adopted for the designation of hazardous wastes:

Class 1: Explosives

Class 2: Gases

Class 3: Flammable liquids

Class 4: Flammable solids

Class 5: Oxidizing substances and infectious substances

Class 6: Poisonous substances and infectious substances

Class 7: Radioactive materials

Class 8: Corrosive substances

- c) Criteria used in describing Class 9 wastes, include:

- chronic toxicity
- carcinogenicity, mutagenicity, and
- teratogenicity
- aquatic and phyto-toxicity
- bio-accumulation
- persistence
- minimum quantity and threshold concentration

I-3 MISA'S EMPPL CRITERIA

The Effluent Monitoring Priority Pollutants List (EMPPL) criteria have been developed by the Hazardous Contaminants Co-ordination Branch (MOE) for the support of the Municipal/Industrial Strategy for Abatement (MISA) program. The purpose of the EMPPL program, derived from the Vector Scoring System, is to identify and assess the relative hazard of contaminants present in municipal and industrial discharges into surface water in Ontario.

A scoring program called the Vector Scoring System, was developed by the MOE Priority List Working Group. The objective of the Vector Scoring System is to identify chemicals of top priority for monitoring programs, research projects and development of guidelines and standards. The scoring system is based on the following criteria:

- a) Environmental mobility (in air, water, soil, sediment and biota);
- b) Environmental persistence;
- c) Bio-accumulation;
- d) Acute lethality;
- e) Sub-lethal effects (on non-mammalians, plants and mammals)
- f) Teratogenicity;
- g) Genotoxicity/mutagenicity; and
- h) Carcinogenicity.

Exposure Assessment

Once the environmental effects of the chemicals have been assessed, the assessment of potential human and environmental exposure must be done based on specific exposure standards. The MISA Priority Pollutant Task Force has developed the following criteria for ranking the environmental exposure:

- a) Detected frequently (>50%) at sampling points;
- b) Potentially present in Ontario
 - detected in natural environment and probable use/manufacture in Ontario;
- c) Inferred to be present in process discharge and probable Ontario use/manufacture;
- d) Possibly present based on literature information only;
- e) Not present, based on analytical data and/or literature.

APPENDIX II: LISTING CRITERIA UNDER REGULATION 309

Introduction:

The listing criteria used in Regulation 309 are described in the following paragraphs. Details of the Vector Scoring System are also included.

II-1 Hazardous Characteristics

Ignitability

Under Regulation 309, a waste is considered ignitable if it meets one of the following criteria:

1. It is a liquid, other than an aqueous solution containing less than 24 per cent alcohol by volume, and has a flash point less than 61°C as determined by any of the following test methods:

ASTM D-56-79,
ASTM D-3243-77,
ASTM D-3278-78,
ASTM D-93-79

Examples of ignitable liquid waste include ethanol, varsol, gasoline, petroleum distillates or paint thinners.

2. It is a solid and is capable, under standard temperature and pressure, of causing fire due to friction, absorption of moisture, or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard.

An example of ignitable solid waste is magnesium dust.

3. It is an ignitable compressed gas as defined by Class 2, Division 1 of the Federal Transportation of Dangerous Goods Regulation (TDGR, 1985).

Class 2, Division 1 gases are defined as substances that:

- a) Have a critical temperature less than 50°C or an absolute vapour pressure greater than 294 kPa at 50°C;

or

- b) Exert an absolute pressure, in the cylinder, packaging tube or tank in which it is contained, greater than 275 ± 1 kPa at 21.1°C or 717 ± 2 kPa at 54.4°C .

and

- (i) Are ignitable at normal atmospheric pressure when in a mixture of 13 per cent or less by volume with air,

or

- (ii) Have a flammability range of at least 12.

Examples of ignitable compressed gases include methane (natural gas), butane or butane mixtures, and propane.

- 4. It is an oxidizing substance as defined by Class 5 of the TDGR (1985).

This includes substances such as chlorates, permanganates, and nitrates which readily yield oxygen to stimulate, or contribute to, the combustion of other materials. Substances that contain the peroxides -O-O- structure are also considered to be oxidizers.

Corrosivity

Wastes that are corrosive as defined in Regulation 309 by any of the following two criteria are hazardous:

- 1. If they are aqueous and have a pH less than or equal to 2.0 or greater than or equal to 12.5.
- 2. If they are liquid and corrode steel (SAE 1020) at a rate greater than 6.35 millimetres per year at a test temperature of 55°C using the National Association of Corrosion Engineers (NACE) test method TM-01-69.

Reactivity

The reactive wastes definition presented in Regulation 309 encompasses a number of diverse properties. Generally, the intent is to include wastes that are susceptible to violent/ vigorous reactions or are likely to generate toxic fumes.

According to Regulation 309, wastes are considered reactive if they:

1. Are normally unstable and readily undergoes violent change without detonating;
2. React violently with water;
3. Form potentially explosive mixtures with water;
4. Generates toxic gases, vapours or fumes in a quantity sufficient to present danger to human health or the environment when they are mixed with water;
5. Contain cyanide or sulphide and when exposed to pH conditions between 2.0 and 12.5, can generate toxic gases, vapours or fumes in a quantity sufficient to present danger to human health or the environment;
6. Are capable of detonation or an explosive reaction if subjected to a strong initiating source or if heated under confinement;
7. Are readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure; and
8. Belong to a Class I explosive as defined by the TDGR. Schedule II List I of TDGR lists most Class 1 explosives.

Leachate Toxicity

Wastes that contain the contaminants listed in Schedule 4 of Regulation 309 such that they can leach out in concentrations that exceed 100 times the concentrations shown in the Schedule are Hazardous. The Leachate Extraction Procedure, included as part of Regulation 309, is used to make this determination.

II-2 Environmental Behaviour Parameters

The criteria used here were adapted from the EMPPL criteria (MOE, 1987; MOE, 1988).

Environmental Mobility

This parameter describes the transport or mobility of chemicals through environmental media such as air, water, soil or biota. The environmental mobility of a chemical is an important factor in evaluating its potential environmental and human health hazards.

Scoring Criteria

The scoring criteria for this element are based on data from monitoring studies or on estimates of environmental partitioning derived from using the Level 1 fugacity Model for organic compounds developed by MacKay (Mackay, 1979; Mackay and Paterson, 1982, 1988). This model uses readily available physico-chemical data to estimate the percentage partitioning of an organic substance into several bulk media (air, water, soil and sediment) and sub-media (air, air-suspended particulates, water, water-suspended particulates, aquatic biota, soil-water, soil-solids, sediment pore-water and sediment-solids) based on an equilibrium steady-state model. The chemical parameters required by the model include vapour pressure, octanol:water partition coefficients, aqueous solubility, and molecular weight. The scoring criteria are set out below.

Fugacity models cannot handle inorganic chemicals. Decisions regarding inorganic chemicals should be based on monitoring data. However, if such data are not available, then inorganic compounds should be given the maximum score as inorganic ions will be widely distributed among the various compartments.

PARAMETER: Environmental Mobility

SCORE	CRITERIA
10	No single medium contains more than 80% of total amount released.
7	Any single medium contains more than 80-90% of total amount released.
4	Any single medium contains more than 90-95% of total amount released.
0	Any single medium contains > 95% of total amount released.

Environmental Persistence

This parameter describes the tendency for a chemical to persist in the environment. Substances in the environment can be subjected to a variety of processes including oxidation, hydrolysis, photodegradation and biodegradation. The net result of such processes may be expressed as the overall persistence of a substance in the environment. When quantified, persistence is usually expressed as the length of time required for one-half of the original amount of a substance to be degraded (i.e. the half-life).

Half-lives of chemicals may vary from seconds to thousands of years (ICF Inc., 1985). Short half-lives generally indicate a lower level of concern. For example, environmental releases of substances with half-lives of less than a few days often will not result in significant accumulation in the environment. Conversely, those with half-lives of several months or longer can lead to substantial exposure or accumulation in the food chain.

Scoring Criteria

The criteria for this parameter are based on half-life values or on general descriptors of persistence. If scores can be assigned using both quantitative and qualitative criteria, the higher score should be used.

If half-life data are available, they will usually pertain to specific media as opposed to general environmental persistence. This information provides an indication of levels of concern regarding specific media. In such cases, the medium providing the highest score will be used.

If persistence values have not been reported and cannot be estimated by using environmental models, other types of information may offer guidance in developing a score for this parameter. For example, structure-activity relationships (SARs) may provide general indications of persistence for relatively unknown substances structurally similar to more familiar substances.

PARAMETER: Environmental Persistence

SCORE	CRITERIA
10	Half-life greater than 100 days; OR designated as very persistent
7	Half-life of more than 50 days but less than or equal to 100 days; OR designated as moderately persistent.
4	Half-life of 10 days but less than or equal to 50 days; OR designated as slightly persistent.
0	Half-life of less than or equal to 10 days; OR designated as not persistent

Bio-accumulation

This parameter describes the tendency for a substance to accumulate in biological systems. In the current context, the term bio-accumulation is intended to convey the ability of a substance to accumulate in the tissues of organisms. The tendency for certain groups or classes of chemicals to bio-accumulate is well documented.

One of the parameters frequently used to express bio-accumulation is the bio-concentration factor (BCF). Most BCF values pertain to fish or other aquatic organisms and are calculated as the ratio of the concentration of a substance in the organism (or some specific tissue) on a wet weight basis to the concentration of the substance in water at steady state (Veith et al., 1980). For organic substances, values of

BCF range from about 1 to more than 1,000,000 (Lyman et al., 1982).

BCF values have also been determined for some terrestrial vertebrates but these data are less abundant and more difficult to locate than those for aquatic organisms. It is recommended for this assessment that data collection efforts first focus on BCF values for aquatic organisms.

The tendency of substances to bio-accumulate in tissue has been related frequently to hydrophobicity or lipophilicity (Veith et al., 1980). As a result, various regression equations have been suggested for predicting BCF values for aquatic organisms based on the octanol-water partition coefficient (K_{ow} : (ratio of concentration of contaminant in octanol to its concentration in water) and other physico-chemical properties. To date, those that use K_{ow} values have been the most widely investigated and most successful (Lyman et al., 1982; Geyer et al., 1984).

Scoring Criteria

Scoring criteria for this parameter are defined in terms of either BCF or $\log K_{ow}$. The correlation between the two sets of criteria is based upon the following relationship developed from experimental data on 84 chemicals (Veith et al., 1980):

$$\log BCF = 0.76 (\log K_{ow}) - 0.23$$

Other equations have been developed based upon various groups of chemicals. When available, an equation which is more directly applicable to a substance being evaluated, should be used.

The bio-accumulation of compounds with relatively high K_{ow} values is influenced by the degree to which a compound dissociates in water. Equations for estimating bio-accumulation that include a dissociation term have not been reported. For the scoring of this parameter, dissociation has not been included as a factor. Consequently, some organic substances may have higher scores than warranted. BCF values can be estimated only to within an order of magnitude using most of the correlations developed to date, and laboratory test situations are incapable of duplicating field situations (Lyman et al., 1982). Therefore, the consideration of dissociation effects may be unimportant for this evaluation.

If scores based on both the actual BCF and the K_{ow} can be determined, preference should be given to the measured BCF values rather than those estimated based on K_{ow} .

PARAMETER: Bio-accumulation

SCORE	CRITERIA	
	BCF	Log K _{ow}
10	>15000	>6.0
7	>500 - 15000	>4.0 - 6.0
4	>20 - 500	>2.0 - 4.0
0	≤20	≤2.0

Environmental Exposure

The environmental exposure refers to the evaluation of the potential for a contaminant to reach a target (or receptor) through some possible pathways. The receptor includes either human or the environment in general (including mammals, non-mammals and plants). The most common pathway for a chemical to reach its target is either surface water, ground water or air. In some circumstances, the target may be exposed to direct contact with the waste.

The exposure assessment is very much a function of the waste management scenario that can be drawn for the waste in concern. To ascertain that scenario, existing waste management practices must be known, and potential mismanagement practices identified from information gathering and survey. The worst-case scenario is developed from the worst situation identified from existing waste management practices, and from other possible mismanagement practices. The environmental behaviour parameters can help assess the efficiency of the pathways to carry the contaminants from the disposal site to the target in concentrations or quantities sufficient to cause adverse effects on the target. Although there is potentially an attenuation of the contaminant concentration from the source (i.e. waste disposal site) to the receptor (human and biota), this estimated attenuation should reflect the worst conditions of attenuation. The total quantity of the contaminant deposited in the environment can also be a factor which will increase the score.

PARAMETER: Environmental Exposure

SCORE	CRITERIA
10	Under conventional waste management practices, the target is likely to be exposed to the contaminant at concentrations sufficient to adversely affect human health or the environment.
7	Under the worst-case scenario, the contaminant has a good potential to reach the target, either because of occasional mismanagement operations, or because of easy pathway between the contaminant source and the receptor.
4	Under the worst-case scenario, the contaminant has a low potential to reach the target and, if it does, it will be at low concentration due to large attenuation effects of the pathway.
0	Under the worst-case scenario, the contaminant has practically no potential to reach the target and affect, even lightly, human health and the environment.

II-3 Toxicity Parameters

Acute Lethality

This parameter describes the acute lethality of a chemical to terrestrial and aquatic animals. Non-lethal or reversible effects are not included.

Acute effects other than lethality (e.g. irritation, allergic reactions, general narcosis, etc.) are considered in other toxicity parameters. Criteria for phytotoxicity are also not included because of the difficulties in assessing lethality in plants.

Scoring Criteria

Scoring criteria for acute oral and dermal LD₅₀ and inhalation and aquatic LC₅₀ are similar to those utilized by the Transportation of Dangerous Goods Act (DOT, 1984) and the State of Michigan Critical Materials Registry (Michigan, 1979). Scores ranging from six to zero for (oral and dermal LD₅₀) are comparable to the extremely toxic to relatively non-toxic scales outlined in the literature (Hodge and Sterner, 1949; Gleason *et al.*, 1977; Douli *et al.*, 1980). The criteria for scores of 8 to 10 would identify chemicals with greater toxicity than those included in the scales referred to above. These more stringent criteria were adopted to ensure chemicals with extreme acute toxicity are clearly identified by the scoring system.

The scoring criteria for inhalation LC₅₀ are derived from the oral LD₅₀ criteria, assuming a 60 kg individual respires 20 m³ of air daily and that the contaminants have equal biological availability via the oral and inhalation routes of exposure. The aquatic toxicity LC₅₀ data would usually be derived from 96-hour exposures.

Scoring criteria for this parameter are as follows:

PARAMETER: Acute Lethality

CRITERIA

Score	Oral LD ₅₀ mg/kg	Dermal LD ₅₀ mg/kg	Inhalation LC ₅₀ mg/m ³	Aquatic LC ₅₀ mg/L
10	≤0.5	≤0.5	≤1.5	≤0.1
8	>0.5-5	>0.5-5	>1.5-15	>0.1-1
6	>5-50	>5-50	>15-150	>1-10
4	>50-500	>50-500	>150-1500	>10-100
2	>500-5000	>500-5000	>1500-15000	>100-1000
0	>5000	>5000	>15000	>1000

Sublethal Effects, Plants

Sub-lethal effects on plants are highly variable depending on the toxicant. The relative significance of the injury or effect depends on the commodity and the use of the plant. These can be divided into three categories:

- a) The appearance is important, but growth and yield are of much less importance. This is relevant for ornamentals, flower crops, leafy vegetables and fruit;
- b) The impact on growth and yield are the most significant, and visible injury to the foliage, though unsightly, is of less importance. This is relevant for root vegetables, fruits and seeds;
- c) There is no visible injurious effects but the longevity of the commodity has been altered. This is of greatest significance in flower crops and for stored fruit and vegetables;

The toxic effects can generally be assayed using short-term tests with indicator plants. The possible effects include a wide spectrum of responses: inhibition of germination, inhibition of seedling growth, growth abnormalities, reduction in either root or shoot growth, etc. Long-term tests with annual plants may be used to assess chronic effects such as decreased yield or decreased competitiveness (NAS, 1975).

The most commonly tested aquatic plants are algae and duckweed (Lemna minor) (EPA, 1978). Several test methods have been developed that use algae (for example, the U.S. EPA Algal Assay Bottle Test). Duckweed has been used to assess the effects of substances on aquatic macrophytes, (EPA, 1978).

Effects on the genetic make-up of the organism may be assayed using other short-term tests with plant material. These include gene mutations, DNA repair, primary DNA damage and chromosomal aberrations (Sandhu, 1980). Some examples of genetic mutation assays using plants are the measurement of chromosomal aberrations in root tip cells, the Tradescantia micronucleus assay (Sandhu, 1980) and the use of Arabidopsis for measuring the frequency of mutational events at the embryo stage (Redel, 1980).

Scoring Criteria

The score definitions for aquatic plants are very similar to those used in parameters which address sub-lethal effects on aquatic animals.

Various biomonitors have been used for different contaminants with each species displaying characteristic symptoms for a given pollutant. Some of these tests have been standardized to a substantial degree while others are only qualitative indicators. Standardized sampling methods have also been devised for substances that accumulate in vegetation and that are toxic to animals. Lichens are also used as accumulators or as indicators for presence (or absence) of a variety of contaminants.

Standardized tests have been reported for relatively few substances. In some cases, the scoring system can accommodate results expressed in concentration units (mg/L for substance in water, mg/m³ for gaseous contaminants, and mg/kg for substances in the soil), but in most instances, the length of exposure is very important.

Soil extraction procedures are critical in determining the level of a contaminant, since the total amount of contaminant available by acid extraction may not be the same amount bio-available to the plant.

The scoring criteria for sublethal effects, plants are as follows:

Parameter: Sublethal effects, plants

<u>CRITERIA</u>				
<u>Per cent of Growth Reduction</u>				
<u>SCORE</u>	<u>MEDIA</u>	<u>≤ 5 % (=NOAEC)</u>	<u>> 5-50 % (=EC₅₀)</u>	<u>>50 %</u>
10	water (mg/l)	<0.001	<0.01	<0.1
	air (mg/m ³)	<0.01	<0.01	< 1
	soil (mg/kg)	<0.01	<0.01	< 1
8	water (mg/l)	0.001-0.01	0.01-0.1	0.1-1
	air (mg/m ³)	0.01-0.1	0.1-1	1-10
	soil (mg/kg)	0.01-0.1	0.1-1	1-10
6	water (mg/l)	>0.01-0.1	>0.1-1	>1-10
	air (mg/m ³)	>0.1-1	>1-10	>100
	soil (mg/kg)	>0.1-1	>1-10	>100
4	water (mg/l)	>0.1-1	>1-10	>100
	air (mg/m ³)	>1-10	>10-100	>1000
	soil (mg/kg)	>1-10	>10-100	>1000
2	water (mg/l)	>1-10	>10-100	>1000
	air (mg/m ³)	>10-100	>100-1000	>10000
	soil (mg/kg)	>10-100	>100-1000	>10000
0	water (mg/l)	>10	>100	>1000
	air (mg/m ³)	>100	>1000	>10000
	soil (mg/kg)	>100	>1000	>10000

Sublethal Effects, Mammals

This parameter describes potential long-term effects of chemicals in mammals. The effects are directed primarily at human health. Although the actual data used will largely be from laboratory animals, data from epidemiological studies will have priority. Other scoring systems (see Hushon and Kornreich, 1984) generally score chemicals for sub-lethal toxicity based on specific effects (e.g., separate scores for carcinogenicity, mutagenicity, teratogenicity, etc.), but most do not address systemic toxic effects. The toxic effects included in this parameter are restricted to sub-lethal systemic effects, but do not include carcinogenic, mutagenic or teratogenic effects since these are included in other parameters.

Scoring Criteria

If data on the effect of chemicals are available but at an unsuitable duration of exposure, the criteria should be corrected by an appropriate extrapolation factor to adjust for potential effects at the suitable exposure period. Criteria used in the development of scores for this parameter would be derived from sub-chronic (generally 90-day exposure) or chronic (usually 1 year or more) exposure studies in any mammalian species. If the data were derived from sub-chronic studies, it is recommended that the NOAEL (No-Observable-Adverse-Effect-Level) be divided by a 10-fold extrapolation factor (see FDA, 1982; Dourson and Stara, 1983). If the only data available involved even shorter term exposures, it is recommended that a 100-fold extrapolation factor be used. Considerable judgement will be required in the utilization of such extrapolation factors, considering issues such as the biological half-life of the chemical, the biological characteristics of the test system from which the data was derived, and knowledge of the usual consequences of the type(s) of adverse effects produced.

The scoring criteria for this parameter do not provide for differences in the type of toxic response observed. For example, if the effects associated with exposure are irreversible, the consequences of exposure are much more serious than if the effects are reversible, following cessation of exposure. For the purposes of this assessment, all effects are considered as equal, but details of differences in the severity of the effects should be carefully noted.

Examples of the various end-points included as chronic systemic effects are as follows:

a) Reproduction Toxicity

- Adverse effects on reproduction as they affect the survival, development and well-being of the species, including interference with gonadal functions but excluding teratogenic effects.

b) General Toxicity

- General gains and losses in body weight, behavioural alterations and increases in diseases secondary to chemical exposure.
- Gross or microscopic alterations in tissues, indicative of disease from toxic events.
- Adverse or deleterious effects on organ systems or functions, alterations in secretions of exocrine and endocrine glands, alterations in the brain and peripheral nervous systems.
- Bio-chemical effects related to treatment.

If data are available on more than one of these effects, the effect occurring at the lowest exposure level in the most sensitive test system should be used in scoring. In addition, structure-activity relationships may provide estimates of the occurrence of chronic effects if data on the actual compound are lacking. Structure-activity relationships appear reasonably predictive for certain types of effects (e.g., narcotic effects). However, little predictive value is obtained for other effects using available methods. In the future, the accuracy of structure-activity relationships in predicting effects between different chemicals may improve.

The scoring system for this parameter is as follows:

PARAMETER: Sublethal Effects, Mammals

SCORE	CRITERIA ¹	
	ORAL NOAEL mg/kg	INHALATION NOAEL mg/m ³
10	<0.1	<0.3
8	>0.1 - 1	>0.3 - 3
6	>1 - 10	>3 - 30
4	>10 - 100	>30 - 300
2	>100 - 1000	>300 - 3000
0	>1000	>3000

¹ Criteria are based on data from exposures of 90 days or more in duration. If data from studies of 28 to 89-days exposure are used, divide data values by 10. If data from studies of less than 14 days duration are used, divide data values by 100.

Sublethal Effects, Non-Mammals

This parameter describes potential effects from long-term exposures of non-mammalian species to chemicals. The effects-data may be expressed as median effective concentration (EC_{50}), maximum acceptable toxicant concentration (MATC) or no-observable -adverse-effect-concentration (NOAEC).

The most frequently reported data of these types are EC_{50} values for fish or other aquatic organisms such as daphnia. Associated with an EC_{50} value is the species studied, the endpoint(s) observed, and the duration of exposure. Common endpoints are immobilization, loss of equilibrium, effects on reproduction and other sub-lethal effects. As with other parameters, if different indicators of effects are available, the most sensitive would be used, unless scorer judgement indicates otherwise.

As with mammalian toxicity, duration of exposure is important to the interpretation of the results. For aquatic organisms, either full or partial life-cycle tests are preferred for the assessment of reproductive effects. Such tests may last as few as seven days or extend beyond a year depending on the life cycle. For terrestrial animals, periods of exposure usually last several months. For other types of effects, results from 96-hour exposures generally have more credence than shorter exposures. In addition, preference should be given to tests on freshwater species native or introduced to North America.

Scoring Criteria

Based on published results of the effects of many substances on aquatic organisms, the NOAEC values that appear in the score definitions are a factor of 100 lower than EC_{50} values (Konemann and Visser, 1983).

The scoring criteria for this parameter are as follows:

PARAMETER: Sublethal Effects, Non-Mammals

Score	<u>CRITERIA</u>			<u>TERRESTRIAL</u>	
	<u>AQUATIC</u>			<u>SUBCHRONIC</u>	<u>CHRONIC</u>
	<u>EC₅₀</u> <u>(mg/L)</u>	<u>MATC</u> <u>(mg/L)</u>	<u>NOAEC</u> <u>(mg/L)</u>	<u>NOAEL</u> <u>(mg/kg)</u>	<u>NOAEL</u> <u>(mg/kg)</u>
10	<0.02 ¹	<0.002 ¹	<0.0002 ¹	<1 ¹	<0.5 ¹
8	<0.02 ²	<0.002 ²	<0.0002 ²	<1 ²	<0.5 ²
6	0.02 - <0.2	0.002 - <0.02	0.0002 - <0.002	1-<10	0.5-<5
4	0.2 - <2	0.02 - <0.2	0.002 - <0.02	10 - <100	5 - <50
2	2 - <20	0.2 - <2	0.02 - <0.2	100 - <1000	< 50- <500
0	≥20	≥2	≥0.2	≥1000	≥500

¹ in different genera

² in one genus

Maximum Acceptable Toxic Concentration (MATC) values are 10 times lower than EC₅₀ values.

Teratogenicity

This parameter describes the potential teratogenic effects of chemicals on mammalian systems. Toxic effects on reproduction in plants, non-mammalian and mammalian systems, as distinct from developmental defects, are described in the previous sections. The production of terata by exposure to chemical contaminants can seriously compromise the development

and survival of offspring. Such effects are usually irreversible, although current understanding is that they have an exposure threshold (EPA, 1984).

The criteria for these effects are as outlined by the U.S. Environmental Protection Agency (EPA, 1984). Teratogenic effects include frank developmental malformations detrimental to the survival, future development, or well-being of newborn. They do not include developmental anomalies and aberrations that appear to be secondary to embryo-, feto- and material toxicity (see EPA, 1984; Khera, 1981). Many such effects are known to disappear as development proceeds (e.g., reversible delayed ossification of various parts of the skeleton, delayed development of specific organs, delayed eye opening, delayed vaginal opening, reduced body weight) (Khera, 1981). In some cases, exposure of pregnant females to chemicals can result in malnutrition due to decreased food intake. Malnutrition has been shown to delay embryo and fetal development, reduce birth weights and, in severe cases, produce irreversible neurological and metabolic abnormalities (EPA, 1984; Khera, 1984). These differences in the apparent severity between frank terata and minor developmental anomalies from chemicals are reflected in the scoring criteria for this element.

Scoring Criteria

Working from the assumption that teratogenic effects exhibit exposure thresholds (Khera, 1981; EPA, 1984), scoring criteria are based on gradations in exposure levels associated with effects. Since teratogenic effects are viewed as more serious than developmental anomalies as outlined above, higher scores are applied to chemicals showing evidence of frank teratogenicity. Chemicals producing developmental anomalies, as outlined previously, are assigned lower scores.

Duration of exposure is particularly critical in assessing teratogenic effects. To adequately assess the potential for such effects from a chemical, the exposure should occur at least through the period of organogenesis (e.g., usually from late in the first trimester through early in the third trimester of gestation). In addition, the levels of exposure studied should be sufficient to elicit a range of effects in the dams, from toxicity at the higher exposures to no-observable effects at the lower exposures (Grice et al. 1975; EPA, 1984; Khera, 1981).

The general requirements regarding route of exposure discussed earlier also apply to teratogenicity assessments.

The scoring criteria for this parameter are as follows:

PARAMETER: Teratogenicity

SCORE	CRITERIA
10	- Teratogenic effects observed without overt maternal toxicity at maternal exposures ≤ 0.1 mg/kg/day during organogenesis, or at equivalent exposure ¹
8	- Teratogenic effects observed without maternal toxicity at maternal exposures $> 0.1 - 1$ mg/kg/day during organogenesis or equivalent exposure
6	- Teratogenic effects or developmental anomalies observed at maternal exposures $> 1 - 10$ mg/kg/day during organogenesis or equivalent exposure.
4	- Teratogenic effects or developmental anomalies observed at maternal exposures $> 10 - 50$ mg/kg/day during organogenesis or equivalent exposure
2	- Teratogenic effects or developmental anomalies observed at maternal exposures $> 50 - 1000$ mg/kg/day during organogenesis or equivalent exposure
0	- No terata or developmental anomalies observed, or observed only at maternal exposures ≥ 1000 mg/kg/day or equivalent exposure

¹ The definition of equivalent exposure assumes that teratogenic effects by dermal or inhalation exposures would be similar to effects by oral exposures, at comparable doses. For inhalation exposures, it is assumed that a 60 kg adult respires 20m^3 of air daily, which explains the factor of 3 between oral (or dermal) doses (mg/kg) and inhalation doses (mg/m³).

Mutagenicity

This parameter describes the mutagenic and genotoxic potential of a chemical. Such effects in themselves are indicative of potential hazards of chemicals to health and the environment. In addition, the strength of such evidence is valuable in the interpretation of other potential hazards from chemicals (e.g., carcinogenicity).

Genotoxic or mutagenic effects on somatic or germ cells are considered equal potential hazards. Assessment of the potential for germ cell mutations requires specific tests (e.g., dominant lethal test, mouse heritable translocation assay) and results from such tests are not available for large numbers of chemicals. Chemicals, for which evidence of germ cell mutations are available, would receive higher scores, than chemicals with evidence of somatic mutations only.

Scoring Criteria

Higher scores are assigned to chemicals with adequate evidence of mutagenic/genotoxic effects derived from short-term tests. The primary objective is to score the potential of a chemical to produce such effects.

Chemicals producing direct mutagenic/genotoxic effects in the absence of overt toxicity are assigned the highest scores (e.g., the chemical or its activated metabolite(s) directly acts on genetic material to produce mutations or genotoxic effects). Clastogenic effects produced by chemicals that do not directly interact with genetic material are scored in the next category. Chemicals causing mutagenic or genotoxic effects indirectly by interfering with various cellular systems would receive lower scores. Scores of two or four should be assigned to chemicals having positive evidence from certain test systems but clear evidence of lack of effects in other test systems.

It is assumed that all test data will be derived under optimal experimental conditions (e.g., using validated test procedures, including appropriate S-9 metabolic activating systems, adequate control for unusual chemical/physical characteristics of the test chemicals).

PARAMETER: Mutagenicity

SCORE

CRITERIA

-
- | | |
|----|---|
| 10 | Conclusive evidence of mutagenicity or Genotoxicity in recognized prokaryotic or eukaryotic test systems at exposure levels not producing overt toxic effects (<u>in vivo</u> and <u>in vitro</u> eukaryotic data are positive or are absent). |
| 8 | Evidence of clastogenic effects (general DNA damage, strand breaks, sister chromatid exchange), intercalations or crosslinks but no evidence of increased incidences of mutations or direct interactions with genetic material. |
| 6 | Does not interact directly with DNA, but interferes with cellular mechanisms such as DNA synthesis and DNA repair. Effects may be observed at exposure levels associated with overt toxicity unrelated to genetic effects. |
| 4 | Mutagen/genotoxin in prokaryotic systems only (i.e., data from eukaryotic test systems are negative). |
| 2 | Mutagen/genotoxin in <u>in vitro</u> systems only (i.e., data from <u>in vivo</u> systems are negative). |
| 0 | No evidence of mutagenic or genotoxic effects in a comprehensive battery of test systems. |
-

Carcinogenicity

This parameter describes the potential of chemicals to cause cancer. There is general agreement that radiation, biological, physical and chemical agents can cause or promote cancer. In addition, the biochemical and molecular process of cancer development, as it is understood, is similar among mammalian species (NTP, 1984; OSTP, 1985). It is evident that the development of cancer is a mutli-stage process involving interactions of agents with genetic material (the genome). The induction of cancerous growths through interactions with the genome may occur directly through the induction of somatic mutations or indirectly by

alterations in gene expression. A number of factors affect the occurrence of these events, including age, sex, genetic differences, strain and species differences, diet, dose rate, route of exposure, interactions with other agents and a variety of environmental conditions (NTP, 1984; OSTP, 1985). Furthermore, the production of these effects by a chemical may be by direct action of the chemical or its metabolites (e.g., direct acting, genotoxic carcinogens) or indirect through actions of the chemical on systems that secondarily produce cancerous growths (e.g., non-genotoxic or epigenetic mechanism). Although the detailed mechanism(s) of cancer production are not fully understood, it is evident that once the required modification in the genome occurs (known as initiation), the process is irreversible and self-propagating. A wide range of factors affect the initiation process, however, and many of these are believed to be reversible (IRLG, 1979; NTP, 1984; OSTP, 1985).

Although the exact mechanisms of the various stages of carcinogenesis are not fully understood, it is apparent that the events leading to the initiation of cells are dose-related. Once initiation has occurred, however, the subsequent development of tumours is independent of the exposure level (IRLG, 1979). This information is important to the scoring of the carcinogenic potential.

Based on this brief summary of what is known about the process of carcinogenesis (refer to IRLG, 1979, NTP, 1984 and OSTP, 1985, for more detailed discussions), the scoring criteria for this parameter differentiate between direct acting and indirect acting carcinogens. It is important that the scoring system not merely reflect the completeness of the data base because only a few chemicals have been adequately studied from an epidemiological point of view in human populations to assess their carcinogenicity. For many chemicals, epidemiological studies to assess their carcinogenic potential will never be conducted and complete reliance will have to be placed on animal bioassay data for their evaluation. If the data from animal bioassays are considered conclusives, "epidemiologically proven" and "potential human" carcinogens (i.e., positive in animal bioassays) are given equal weight in the scoring system.

Scoring Criteria

The following definitions of carcinogenicity are used in scoring this parameter (Tomatis, 1979):

- Evidence of carcinogenicity is positive when an increase in malignant tumours is caused in more than one species or strain, in multiple experiments with varying routes or levels of exposure or to an unusual degree with respect to type, site, incidence or latency period.
- Evidence of carcinogenicity is negative when no tumour induction is observed in at least two adequate and appropriate animal studies in different species or in both animal and epidemiology studies.
- Evidence of carcinogenicity is inconclusive when neither of the above two conditions apply, usually because the observations are inadequate, of unacceptable quality or excessively limited. Contradictory results from different test systems may also lead to an inconclusive assessment. Such conditions are recorded as either positive or negative for carcinogenicity.

There is a great deal of controversy regarding the potency ranking of carcinogens, particularly when attempting to denote the potency of a chemical to cause cancer in man from data derived from animal cancer bioassays. Animal bioassays utilize high exposure levels (known as the Maximum Tolerated Dose or MTD protocol, see NTP, 1984; OSTP, 1985). Judgements of carcinogenic potency based on information derived from such high levels of exposure may have little relationship to potencies at lower levels of exposure comparable to those found in the environment. Consequently, the basis for potency ranking is not considered adequately developed for use in a scoring system. However, if procedures for such ranking were found reliable, they would form a reasonable basis for the scoring of the carcinogenic potential of chemicals.

Important information to assist in the interpretation of animal cancer bioassay data vis-a-vis the potential of a chemical to cause cancer in humans can be derived from assessments of its mutagenicity/genotoxicity.

PARAMETER: Carcinogenicity
SCORE

CRITERIA

-
- | | |
|----|--|
| 10 | Direct acting human carcinogen or potential human carcinogen (based on animal bioassay data) with evidence of direct interactions with genetic material. Acts as an electrophile or direct alkylating agent, produces DNA adducts, induces cell transformation, etc. |
| 8 | Indirect acting human carcinogen or potential human carcinogen (based on animal bioassay data) with evidence that it does not interact with genetic material. |
| 6 | Carcinogenic in animal bioassay tests at levels of exposure shown to saturate enzymes involved in the metabolism of the compound or at exposure levels shown to cause histopathological lesions known to predispose animals to the development of cancers at sites where the lesions are observed (e.g., ATPase deficient liver foci in rodents). Adequate evidence must be available, demonstrating that no interactions occur with genetic material and that the chemical does not induce cell transformation. |
| 4 | Positive tumorigenic agent (benign tumours) in humans or animals. Evidence of lack of interactions with genetic material must be available. Includes chemicals that act solely as promoters and those that cause cell transformation <u>in vitro</u> without evidence in other systems. |
| 2 | Tumorigenic in only one animal species and negative in other(s) (all studies considered adequate). |
| 0 | Not tumorigenic in an adequate animal bioassay in at least two species and must not interact with genetic material. |
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VOLUME B
GUIDANCE MANUAL
FOR THE REVIEW OF WASTES
LISTED IN REGULATION 309

AUGUST, 1989

ONTARIO
MINISTRY OF THE ENVIRONMENT
WASTE MANAGEMENT BRANCH

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- IV: Regulation 11/82: Waste Management - PCB's
- V: Waste Review Application Form

BIBLIOGRAPHY

1.0 INTRODUCTION

1.1 Purpose of this Manual

Under Regulation 309 of the Environmental Protection Act (EPA), the Ontario Ministry of the Environment (MOE) has listed near 100 industrial waste streams as hazardous industrial wastes, (Reg. 309 Schedule 1) and near 700 commercial products as acute hazardous or hazardous waste chemicals (Reg. 309, Schedule 2, Parts A and B). These wastes were listed because they typically and frequently exhibit one or more of the characteristics of hazardous wastes, or they contain certain specific constituents that are known to be toxic or otherwise hazardous. If a waste from any facility can be identified in Schedule 1 or if a product/byproduct, identified in Schedule 2 (A and B), is disposed of as a waste, the waste is regulated as hazardous. Schedules 1 and 2 were derived from similar lists prepared by the United States Environmental Protection Agency (USEPA).

The Ministry provides for an ongoing mechanism for adding hazardous wastes to the existing lists. This listing process may be initiated by members of the public, industry or government. This request for examination of an unlisted waste (believed to be hazardous) may be directed to the Waste Management Branch of the Ministry and does not require the proponent to submit extensive documentation. The listing procedures of the Ministry are detailed in the "Guidance Manual for Hazardous Waste Categorization and Review Program - Volume A: Categorization of Hazardous Wastes", (MOE, March, 1989). Generally speaking, each listed substance will have a background document providing the rationale for such listing.

The MOE recognizes, however, that a listed waste from a particular facility may not actually be hazardous. This could be the case if the waste:

- a) does not exhibit the characteristics or does not contain the constituents for which it was originally listed;
- b) contains these constituents at relatively low concentrations (below any concentration of

concern, considering the waste management practices used).

These situations could occur, for example, if a facility uses or processes raw materials different from the ones assumed when the Regulation was written. Regulation 309 (Sections 1 (2), 1 (26) and 1 (28)) provides the opportunity to "delist" or review the status of such a waste, in other words, to exclude it from the Schedule. It is emphasized that this type of review pertains only to a specific waste from a specific facility.

A decision on this must draw upon existing standards and guidelines in various jurisdictions and may require a risk assessment. When very little information is available as to the health and environmental risk of the waste, the waste shall not be delisted. This is to ensure that the decisions will be conservative and err on the side of caution.

It should be noted that if delisted, the waste still remains a waste, and will have to be managed according to practices required as part of the approval of such a review. It is also emphasized that dilution of a listed waste as a strategy for lowering the concentration of contaminants is not acceptable to the Ministry.

The purpose of this manual is to assist generators of hazardous wastes wishing to submit a review application. To ensure that hazardous wastes do not endanger the environment, the review procedure requires the submission of the following information:

- a) processes and chemicals used;
- b) results of tests for hazardous constituents and hazardous waste characteristics;
- c) waste management practices currently in effect, on-site and off-site;
- d) identification of proposed waste management sites and practices when and if waste is reviewed; and status of the waste if reviewed (e.g. still hazardous for other reasons, liquid industrial, municipal, etc.);
- e) other related information, such as economic impact assessments will need to be examined.

Due to the complexity and the extent of information required, this manual is intended to provide guidance during the review process. It is suggested that the applicant obtain a copy of Regulation 309

(from the local Ministry office), as frequent references are made to this regulation. Detailed discussions with the appropriate Regional and Waste Management Branch staff prior to submitting an application is essential.

1.2 Listing of Hazardous Wastes under Regulation 309

It is important for the applicant to understand how hazardous waste is defined and listed, because the listing rationale forms the basis for the review process.

The Ministry of the Environment is using the same initial approach for listing hazardous wastes as the one used by the United States Environmental Protection Agency (USEPA) (see Bibliography). Minor changes were incorporated in the writing of Regulation 309, to reflect Ontario and Canadian requirements. These changes have been included in Volume A of this Guidance Manual. Any waste is listed as hazardous waste if it meets one or more of the following criteria, or is a waste of a type or from a type of waste stream which typically meets one or more of the following criteria:

- 1) It exhibits any one of the hazardous waste characteristics:
 - Ignitable
 - Corrosive
 - Reactive
 - Radioactive *
 - Leachate Toxic

(Refer to Section 3.2.4.1 and Appendix I for further details).

- 2) It has been found, by scientific research, to be fatal to humans in low doses; or, in the absence of human toxicity data, it has any of the following properties:

* Materials which are considered radioactive will not be reviewed; even if they fail to exhibit the properties for which they were originally listed.

- ° an oral LD₅₀ (rat) less than 50 mg/kg,
- ° an inhalation LD₅₀ (rat) less than 2 mg/L,
or
- ° a dermal LD₅₀ (rabbit) less than 200 mg/kg;

(LD₅₀ refers to the contaminant dose where 50% of the specimens (rats, rabbits, etc.) died).

or it has been found to otherwise cause or contribute to serious irreversible or incapacitating illness. Such a waste is called an acute hazardous waste, and is subject to control at smaller quantities than other hazardous wastes.

- 3) It contains one or more of the hazardous constituents listed in Appendix III of this manual, unless after consideration by the MOE, the waste does not pose a substantial threat to human health or the environment when improperly managed or disposed of.

Many of these constituents have been shown to cause cancer, genetic mutation or embryonic damage in humans or other animals.

Using these criteria, three lists of hazardous wastes were produced and are included in Regulation 309:

- i) Hazardous industrial wastes (Schedule 1). These consist of spent solvents and electroplating wastes (non-specific sources) and residues from manufacturing and wastewater treatment processes (specific sources).
- ii) Acute Hazardous waste chemicals (Schedule 2, Part A); discarded commercial chemical products, off-specification manufacturing intermediates and spill residues thereof. This list is based on all three criteria noted above. The definition of commercial waste chemicals includes materials such as pharmaceutical or pesticide waste products that contain active ingredients from Schedules 2 (A) and 2 (B). Active ingredients are chemical constituents that have been included in a formulated product for an intended effect.
- iii) Hazardous Wastes Chemicals (Schedule 2, Part B); these discarded commercial chemical products, off-specification intermediates are less hazardous than the ones mentioned above.

Unlike the listing approach used in Schedule 1 and 2, other wastes fall within the definition of hazardous waste if they meet one or more of the hazardous characteristics, as outlined in Appendix I (i.e. ignitability, corrosivity, reactivity, radioactivity and leachate toxicity). In addition, pathological and PCB wastes are specifically identified as hazardous in the Regulation.

1.3 Rationale for the Review Process

Because of the complexity of the toxicity evaluation of certain chemicals, some wastes from specific industries and active chemical ingredients of commercial wastes have been listed in Regulation 309. However, the MOE has made provisions in Regulation 309 for a process of review of hazardous wastes from Schedule 1 and Schedule 2 (Parts A and B).

The applicant must show, by means of a comprehensive sampling, testing and reviewing program, that the waste in question does not meet any of the criteria for which the waste was originally listed. In addition, the applicant must provide additional information regarding other hazardous properties or other constituents present in the waste at significant levels. Other potential impacts of the waste review must be considered: effect on the specific site, impact upon alternative waste disposal facilities and provincial waste management practices.

The review process requires that the applicant provide a comprehensive description of the waste to be reviewed, so that the additional possibility of the presence of other factors (other than those for which the waste was originally listed) which might cause the waste to be hazardous, can be evaluated.

While the review process appears to require a large volume of information, it is justified by the seriousness of the harm that could result if hazardous wastes were to be improperly reviewed and thus allowed to endanger the environment. The clean-up costs could significantly exceed the savings in waste management costs resulting from a review error. Therefore all aspects must be considered in detail.

2.0 STEPS OF THE REVIEW PROCESS

This section summarizes the review process. Each step is detailed in the following sections and illustrated in Figure 1.

1) Submission of application

Once the applicant is familiar with the requirements of the review process as described in this guidance manual, a review application can be submitted to the Hazardous Waste Listing Unit (HWLU), Waste Management Branch, of the Ministry of the Environment (see Figure 1).

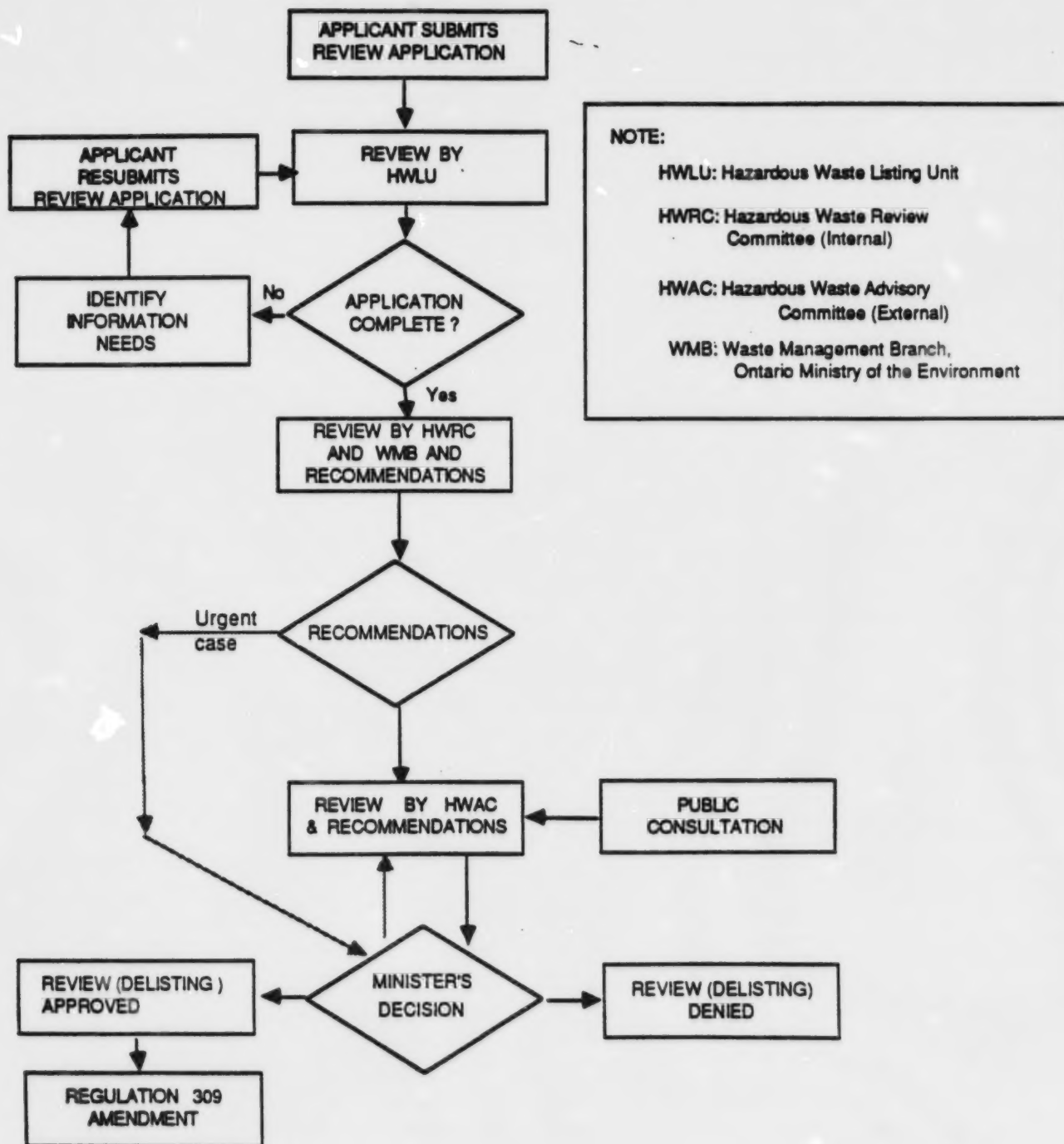
After preliminary review of the original application corrections and additional information from the applicant may be required.

2) Evaluation of the application

During a normal review exercise, the following will be involved in the review of the application:

- a) Hazardous Waste Listing Unit (HWLU)
- b) Hazardous Waste Review Committee (HWRC)
(internal MOE committee);
- c) Waste Management Branch Director (WMB);
- d) Hazardous Waste Advisory Committee (HWAC)
(external committee);
- e) The Public;
- f) Minister of the Environment.

Figure 1: HAZARDOUS WASTE REVIEW (DELISTING) PROCESS



The review (delisting) document is examined by the (internal) Hazardous Waste Review Committee (HWRC), consisting of a member from each branch of the MOE and a member from the Ministry of Labour. The recommendations of this Committee are provided to the Director, Waste Management Branch, who forwards the document and the recommendations to the Minister's (external) Hazardous Waste Advisory Committee (HWAC). This Committee is charged with the responsibility of evaluating the recommendations of MOE and ensuring that adequate public consultation takes place on this issue. The HWAC submits its recommendations to the Minister of the Environment.

3) Ministry's decision

If the Minister agrees with the HWAC recommendations and a decision is made for a review (delisting) of the waste, Regulation 309 will be amended to include the reviewed waste (from the specific site and process) in the appropriate 'E' Schedule of the Regulations, along with the specific range of conditions under which the review (delisting) is applicable. Should the waste exceed the maximum allowable concentration of contaminants, it would be considered as hazardous and would require appropriate management.

It should be noted that a specific reviewed (delisted) waste is still classified as a waste.

3.0 INFORMATION REQUIRED

The MOE requires sufficient information in order to determine the waste characteristics and the possible presence of toxic constituents in the waste.

3.1 Description of the Manufacturing Process

The MOE requires information on the manufacturing operations or other processes which generate the waste. The applicant may choose either to provide a detailed list of raw materials and an evaluation of the fate of these chemicals in the waste, or to test for Appendix III hazardous constituents in the waste stream. It may also be necessary to provide information related to the nature and quantity of by-products that may be generated in the process.

3.1.1 General Information of the Process

The description of the manufacturing processes or other operations that produce the listed waste may include for example, and as appropriate, the following items:

- ° A description of production lines and major items of equipment; description also of the stages of the typical operation cycle (e.g. start-up, steady-state operation, cleaning and maintenance) on a daily, weekly, or other basis as appropriate.
- ° A description of any surface and equipment preparation, cleaning, degreasing, coating or painting processes used in the facility that have not been included in the description of the production lines.
- ° A schematic diagram of all manufacturing processes, surface preparation, cleaning, and other operations that may contribute to the waste.

The applicant needs to provide sufficient information to allow the Ministry to understand the process, how and where the waste is formed, and how any toxic constituents may end up in the waste. In particular, variations from typical processes in that industry should be noted.

3.1.2 Assessment of Hazardousness

The applicant may use either of the two approaches described below to provide information on those constituents that may be present in the waste. Approach A relies on a material inventory to assess the nature of the waste, whereas Approach B relies on a comprehensive analysis program of possible contaminants. Prior consultation with the Ministry would assist the applicant in making the correct choice. In many cases, Approach 'A' may be more desirable when the wastes are produced by stable, predictable processes.

Approach A:

- A1) The applicant must provide a list of all materials used in the manufacturing or other operations that produce the waste. To the extent possible, the chemical name rather than the generic name (e.g. "sodium hydroxide" instead of "caustic cleaner") should be used. The approximate quantities used annually should be specified. Examples of materials to be included are:

Raw Materials
Intermediate Products
By-Products
Products
Oils and Hydraulic Fluids
Surface preparation materials (such as lubricants, solvents, acids, cleaners, surface preparation agents, paints wrapping/packaging, etc.)

- A2) The applicant must indicate which materials on the above list (paragraph A1) are either discharged into the waste, are in contact with the waste, or are likely to be present in the waste. For each material so indicated, an estimate of the amount (in metric units) that enters the waste stream annually must be provided. For materials specified in terms of a generic or trade name, a Materials Safety Data Sheet should be included, if it is available from the suppliers.
- A3) From the above list of all materials that are used or produced at the plant or facility, the applicant must indicate which ones are not discharged into, nor likely to be present in, the waste. The reasons for this should also be indicated.
- A4) The applicant must make an assessment of the likelihood that these processes, operations, or feed materials might produce or contribute to a waste that is not included in this application, or might change the characteristics of the waste. Considerations such as start-up and shutdown operations, maintenance, spills, leaks, on site neutralization, treatment, recycle, stabilization/solidification encapsulation, dilution and other accidents should be included.

A5) For proper characterization of the waste, pertinent test results on representative samples of the waste must be provided by the applicant for the following:

- The specific hazardous constituents for which the waste was listed (i.e. total concentration of each listed constituent found in Appendix III of this manual);
- The hazardous waste characteristics. (Note that an explanation of why the waste does not exhibit a particular characteristic may be provided, in lieu of testing for that characteristic). (See Appendix I);
- Appropriate leachate tests for the contaminants in Schedule 4;
- Total concentrations of the contaminants in Schedule 4 (Reg. 309);
- Total organic carbon (TOC);
- Total oil and grease; and
- Chromatographic scanning for organics and component identification of important peaks.

(Certain tests may not be required if the rationale for not conducting these tests is justified):

Approach B

As an alternative to the information requested in Approach A, the following information can be provided instead:

- B1) Justification must be forwarded for those constituents listed in Appendix III that the applicant does not expect to find (and thus does not analyse for). The explanation may be presented on a substance-by-substance basis or for a group of substances. If the Ministry does not find the explanation satisfactory, analyses of additional constituents or a better explanation will be required;
- B2) Pertinent test results on representative samples of the waste must be provided for the following:

- The specific hazardous constituents for which the waste was listed (i.e. total concentration of each pertinent constituent found in Appendix III of this manual);
- All other constituents listed in Appendix III that could be present in the waste. Where such constituents are found, the applicant shall provide sufficient information to allow for a determination of the significance of the concentration of the constituents;
- The hazardous waste characteristics (see Appendix I);
- Appropriate leachate tests for contaminants in Schedule 4;
- Total organic carbon (TOC);
- Total oil and grease; and
- Chromatographic scanning for organics and component identification of important peaks.

(Certain tests may not be required if the rationale for not conducting these tests is justified):

Selection of constituents for testing

Depending on the approach selected by the applicant, a large number of constituents may be identified. A list of constituents to be analyzed may be determined by specifying:

- ° the chemicals going into the process;
- ° the product coming out;
- ° the chemical and physical reactions of the process.

A mass balance for the process will show what raw materials are used, their use rates, and whether they are likely to be present in the waste at significant concentrations.

- ° For example, consider a process involving the production of aniline by the reduction of nitrobenzene. Based on plant data, for each 100 kg. of nitrobenzene used, 72 kg. of aniline is formed, which indicates that 5 kg. of nitrobenzene is lost in the process per 100 kg. used. Furthermore, it is known

that 20,000 L of wastewater results from the production of each 72 kg. of aniline. Therefore, one can estimate that the maximum concentration of nitrobenzene in the wastewater is about 250 mg/L assuming that all of the nitrobenzene is in the wastewater. Based on this calculation, the generator would likely test the wastewater treatment sludge for nitrobenzene.

The area of by-products is the most difficult to consider, because expert chemical judgement (supported by appropriate examples from the literature) must be applied to predict the types and relative amounts of by-products expected from a reaction.

- ° For example, any reaction involving chlorinated phenols might produce some chlorinated dibenzodioxins, which are considered to be hazardous at trace levels, although it is not a very probable reaction in most circumstances. In such cases, the applicant should include the chlorinated dibenzodioxins as a constituent for testing.

The more detail that is provided in the mass balance analysis, the more likely the review committee is to accept the rationale for which constituents are likely to be present.

- ° For example, if a reactant is described as "technical benzene", questions about the presence of toluene and other aromatics (and their by-products) in the waste stream may be raised. On the other hand, identification of the reactant as "90% benzene, 9% toluene, 1% xylene and less than 10 ppm sulphur" limits the likely composition of the waste stream.

The applicant may not wish to disclose information related to some items of the process. In such cases, a greater burden is placed on the analytical requirements.

- ° In some instances, it may not be possible to construct a mass balance (e.g. chemical mixtures used in maintenance, cleanup, and other non-process applications). In such cases, the applicant should list the known constituents in each mixture and estimate the amounts generated based on usage.

3.1.3 Special Procedures: Petroleum Refinery

Certain industries generate wastes whose constituents vary widely, and for which raw materials data cannot generally be provided. Therefore, the MOE requires the applicants in these industries to perform testing for certain constituents that can reasonably be expected to be present in the waste streams. Also, the MOE requires additional information on manufacturing and waste treatment processes beyond that which was requested in Section 3.1.1 above. The industries covered by these special procedures are Petroleum Refining Industries discussed here, and other multi-waste industries, discussed in the next section (3.1.4).

For the Petroleum Refining industry, the following information on the nature of the waste should be provided, (instead of following Approach A or B).

- 1) Test results on a representative number of waste samples for each of the following:
 - The hazardous waste characteristics (see Appendix I);
 - Appropriate leachate tests for contaminants (Schedule 4 of Regulation 309);
 - Weight of the solid residue remaining after step 4.13 of the Leachate Extraction Procedure (Regulation 309);
 - Total concentrations of leachate toxic metals (Schedule 4, Regulation 309) in the waste;
 - Total organic carbon (TOC);
 - Total oil and grease;
 - If the waste contains greater than 1 per cent oil and grease, both the leachate extraction procedure (LEP) from Regulation 309 and the Extraction Procedure for oily waste (Appendix II) should be used when testing for leachate toxicity;
 - Total concentration of each of the constituents shown in Table 1 (these constituents have normally been shown to exist in the wastes from petroleum refining industries by USEPA);

- Chromatographic scanning for organics and component identification of important peaks.

- ii) An assessment of the likelihood that these processes, operations, or feed materials might produce a waste stream that is not included in this application along with any additional toxic constituents that may be present in the waste. Considerations such as start-up and shutdown operations, maintenance, spills, leaks and other accidents should be included.

TABLE 1

CONSTITUENTS OF WASTES FROM PETROLEUM REFINING INDUSTRIES

1. Metals/Anions

Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Copper
Cyanides
Lead
Mercury
Nickel
Selenium
Vanadium

2. Volatiles

Benzene
Carbon disulfide
Chlorobenzene
Chloroform
1,2-Dichloroethane
1,4-Dioxane
Ethyl Benzene
Ethylene dibromide
Methyl ethyl ketone
Styrene
Toluene
Xylene

3. Semivolatile Base/Neutral
Extractable Compounds

Anthracene
Benzo(a)anthracene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a) Pyrene
Bis(2-ethylhexyl)phthalate
Butyl benzyl phthalate
Chrysene
Dibenz(a,h)acridine
Dibenz(a,h)anthracene
Dichlorobenzenes
Diethyl phthalate
7,12-Dimethylbenz(a)anthracene

Dimethyl phthalate
Di(n)butyl phthalate
Di (n) octyl phthalate
Fluoranthene
Indene
Methyl chrysene
1-Methyl naphthalene
Naphthalene
Phenanthrene
Pyrene
Pyridine
Quinoline

4. Semivolatile Acid- Extractable Compounds

Benzenethiol
Cresols
2,4-Dimethylphenol
2,4-Dinitrophenol
4-Nitrophenol
Phenol

3.1.4 Special Procedures: Multiple Component

Facilities

These facilities (e.g. drum reconditioning) typically receive a number of individual material/waste shipments which have a wide variety of composition. Approach A (raw material inventory) is not adequate to assess the nature of the incoming material and the characteristics of the treatment residues.

A new approach, similar to Approach B but more rigorous, is required in this case.

The applicant must provide the following information in the review applications:

- i) A description of the procedures used in the prescreening of the generators/carriers and the identification of the materials/wastes;
- ii) Test results on a representative number of waste samples for the following parameters:
 - hazardous waste characteristics (see Appendix I)
 - appropriate leachate tests (using oily waste method, Appendix II), including nickel
 - total concentration of leachate extraction procedure metals, including nickel
 - total organic carbon (TOC)
 - total oil and grease
 - cyanide: total, free and leachable
 - long-term stability, using a multiple extraction procedure set by the Ministry (applicable to solidified wastes only)
 - Appendix III Hazardous Constituents: a test for all constituents that are reasonably expected to be present in the treatment residues should be conducted. The rationale for not testing for certain constituents should be presented;
- iii) Statistics on the type of wastes received over a year and identification of the samples representing the waste types;
- iv) Chromatographic scanning for organics and component identification of important peaks.
- v) Quality control and monitoring program:
 - a program should be proposed to monitor the quality of the treatment residues before disposal;

- tests for representative organic contaminants;
- the program should be developed and reviewed with the assistance of the Waste Management Branch (MOE).

3.2 Nature of the Waste

This section provides information on how to describe and quantify the nature of the waste, using sampling, testing and statistical data analysis methods.

3.2.1 Description of the Waste

The lists of regulated wastes are found in Schedules 1 and 2 (Parts A and B) of Regulation 309. From those lists, the applicant must provide the following information regarding the waste which is subject to review application:

- ° Description of the waste stream: the description of the waste stream should be tied in with the description of the manufacturing process (Item 1, Part A), and provide detailed information of the waste generating process. The information should be included in appendices to the application for review;
- ° Waste Class Number (Ontario Classification Number: 3 digits and one letter) and the Product Identification Number (PIN: two letters and 4 digits) from the Transportation of Dangerous Goods Act (TDGA);
- ° Physical state of the waste (i.e. liquid stream, sludge, dry solid; for sludge, the percentage of solid must be indicated).

The applicant must provide the following estimated amounts of waste generated from operating records:

- ° Average/month
- ° Maximum/month
- ° Average/year
- ° Maximum/year

SI units are to be used, vague units such as "truck loads", etc. are not acceptable.

3.2.2 Quality Assurance and Quality Control (QA/QC)

The applicant should include, as part of the description of the sampling and testing procedures, a review of the QA/QC program adopted during any review program. Additional information is available in the Quality Assurance Policy and Guidelines (MOE, 1986).

The Quality Assurance (QA) program refers to activities undertaken to ensure that every possible critical operation has been covered by appropriate control and performance monitoring steps. These activities are usually the responsibility of supervising personnel and include typically:

- documentation of sampling/testing methods;
- identification of critical steps in the methods;
- monitoring performance;
- follow-up on problems identified;
- inter-method comparisons;
- inter-laboratory comparisons.

The Quality Control (QC) program refers to activities undertaken prior to and during the use of laboratory facilities, supplies, equipment, and instrumentation to verify their suitability for the task. The analyst is normally responsible for performing these activities which address typically:

- cleanliness of labwares;
- reagent purity;
- equipment operation;
- instrument stability, drift, noise;
- instrument detector conditions;
- background noise, matrix effects;
- calibration zero, slope, curvature;
- calibration stability (day-to-day);
- response factors and retention times.

In order to ensure that quality is maintained, performance monitoring is done while performing the analytical procedure. Under proper QC procedures, the following activities would confirm the good performance of the system:

- duplicate analysis of samples;
- analysis of blanks;
- use of internal standards;
- in-run checks on baseline/sensitivity drift;

- spike recovery (complete method);
- in-house control materials;
- charts and records related to the above.

3.2.3 Sampling of Waste

The review application must be supported by analytical results of waste samples. The type of results required has been outlined in sections 3.1.2 and 3.1.3. It is particularly important for the applicant to demonstrate in the application that the samples are representative of the waste and that their integrity is preserved until the required analyses are performed.

A simple statement that the samples are representative is not sufficient for the MOE to conclude that the waste has, in fact, been adequately sampled and characterized. In order for MOE to assess the sampling program, the applicant must provide a detailed rationale as to why the collected samples do represent the waste's composition as it varies in time and space. This rationale should be based in part on considerations of how the waste-generating process itself varies.

Depending on the complexity of the sampling program, the applicant may wish, and in certain cases may have, to discuss the sampling program with MOE and to agree on a sampling protocol.

3.2.3.1 Representative Sampling

The selection of a sampling strategy depends on what type of variability the waste exhibits: time or space variability, or both. This aspect is presented in detail in the "Industrial Waste Sampling Guideline" (MOE).

3.2.3.2 Sampling Equipment

Different types of samplers are used for different types of waste and different waste streams. Samplers are described in the "Industrial Waste Sampling Guideline" (MOE) include:

- o trowel or scoop
- o tier
- o grain sampler
- o soil auger
- o dipper (pond) sampler
- o weighted bottle sampler

- ° tubular (profile or case) sampler
- ° tube and ball valve sampler
- ° PACS COLIWASA sampler
- ° concentric tube sampler
- ° regular and constricted glass tubes

3.2.3.3 Specific Sampling Techniques

Specific sampling techniques must be used for various sampling situations. A number of these techniques are presented in the "Industrial Waste Sampling Guideline" (MOE).

3.2.3.4 Sample Handling, Storage, and Documentation

Samples collected must be handled, labelled, and stored so that sample integrity is preserved. In addition, proper documentation of sample collection, preservation, and custody is essential. Details of these techniques are available in "Industrial Waste Sampling Guideline" (MOE).

Handling and Storage

Containers - Samples should be collected and composited in proper containers.

On-Site Preservation - Once a sample has been collected, steps must be taken to preserve the physical and chemical integrity of the sample during transport and analysis. Refer to MOE publication "A Guide to the Collection and Submission of Samples for Laboratory Analysis" (Available from MOE's Laboratory Services Branch).

Identification and Labelling - Each container should be assigned a unique sample identification number, and an indelible label should be secured to the container.

Shipping - After the samples have been preserved, labelled, and sealed, they are ready for shipping. Samples should be shipped and analysed as rapidly as possible by a Ministry-approved laboratory (for Reg. 309). The MOE may also require replicates of some samples to be sent to MOE Laboratory Services for audit.

Documentation

In addition to labels and seals, there are three types of documentation necessary to ensure the

integrity of the sample: a chain-of-custody record, a field log book, and a sample analysis request sheet.

A chain-of-custody record should be filled out and should accompany every sample. The record should contain the following information: sample identification number, signature of collector, date and time of collection, place and address of collection, and waste type.

In addition, all information pertinent to a field survey or sampling must be recorded in a log book.

Finally, a sample analysis request sheet available from Ministry or other laboratories should accompany the sample to the laboratory.

The applicant should preserve all chain-of-custody documents, log books, and similar records in case a question arises regarding the sampling portion of the application.

3.2.4 Selection of Waste Analysis Methods

This section includes a brief description of the methods used in the analysis of waste for the hazardous characteristics and constituents. The waste analysis methods in many cases are complex and may require relatively elaborate laboratory facilities. The design and execution of the testing program should be done by a qualified analytical chemist. If the necessary personnel or laboratory resources are not available in-house the applicant is advised to consult with the Ministry's Regional or Waste Management Branch staff for the selection of a testing laboratory or consultant for the design and execution of the testing program.

3.2.4.1 Tests for Characteristics

The applicant must determine if the waste exhibits one of the characteristics (ignitability, corrosivity, reactivity, leachate toxicity, and if it is severely toxic waste). These determinations may take the form of an explanation of why the waste cannot exhibit one or more of the characteristics. If the applicant cannot conclusively show a characteristic's absence, tests must be carried out on representative samples. (Refer also to Appendix I).

1. Ignitability

This characteristic identifies wastes that either present fire hazards under routine storage, disposal, and transportation or are capable of severely exacerbating a fire once it is started.

2. Corrosivity

This characteristic identifies wastes which might pose a hazard to human health or the environment due to their ability to:

- ° Mobilize or react with toxic metals;
- ° Corrode handling, storage, transportation, and management equipment; or
- ° Destroy or cause injury to human or animal tissue in the event of inadvertent contact.

3. Reactivity

This characteristic identifies wastes which, because of their extreme instability and tendency to react violently or to explode, pose problems at all stages of the waste management process.

4. Leachate Toxicity

The Leachate Extraction Procedure (Regulation 309) is designed to simulate the leaching that a waste will undergo if it is disposed of in a sanitary landfill.

3.2.4.2 Tests for Constituents

In addition to testing for the characteristics as described earlier, the following tests should be conducted as appropriate for the waste stream:

- ° If cyanide was a constituent for which the waste was listed, or if it is expected to be present in the waste, total cyanide should be analysed. If the total cyanide concentration recorded is greater than 1 ppm, test for free cyanide should be done. If the concentration of total cyanide is greater than 10 ppm, the photoconversion test for photo-degradable cyanide should be performed.
- ° If the cyanide analysis indicates the presence of an interference in the wastes that produces non-representative concentrations, the interferences should be noted and explained.

- ° A total constituent analysis by complete acid digestion for all the leachate toxic metals (and nickel if nickel is a constituent for which the waste was listed) should be performed.
- ° The Total Oil and Grease analysis should be done to determine the percentage of oil and grease by weight. The method involves drying the waste and then extracting the constituent oil and grease with an organic solvent;
- ° If the Total Oil and Grease analysis shows that the total oil and grease content of the waste is 1 per cent or more, the Leachate Extraction Toxicity Test for Oily Wastes should be used (see Appendix II);
- ° Total organic carbon should be measured. In this test, organic carbon is converted to carbon dioxide by analytic combustion or wet chemical oxidation. The CO_2 formed can be measured or converted to methane (CH_4) and measured. The amount of CO_2 or CH_4 is directly proportional to the concentration of carbonaceous material in the sample;
- ° The organic constituents most likely to be present in the waste should be identified and quantified.

If chromium, cyanide, and nickel are listed constituents, tests for these may be combined with the Leachate Extraction Procedure test. For the first two compounds, the following special procedures apply:

- ° Total chromium and hexavalent chromium must be analyzed separately in the Leachate Extraction extract. Initial and final pH data on the hexavalent chromium Leachate Extraction analysis must be reported. If the pH drops from an alkaline or neutral value to an acidic pH, then alkaline digestion of the waste is required before analysing for total concentration of hexavalent chromium;
- ° In cases of mercury contamination, both organic and inorganic forms of mercury shall be tested.
- ° A test should be conducted for extractable cyanide using the Leachate Extraction procedure, using distilled water only (instead of acetic acid) as the extract medium.

3.3 Description of Waste Management Practices

The applicant should describe how the wastes are presently managed. The description should include the following:

- ° A paragraph describing current waste management techniques (e.g. landfill, lime treatment, incineration, etc.) and the location of the waste management system (on-site or off-site);
- ° A schematic flow diagram of the waste management system, showing the processes (stock piling, bulking, barreling, etc.), equipment and storage methods used;
- ° The names and locations of any commercial treatment, storage, or disposal facilities that are used for the waste.

The applicant must also describe the plan for disposal of the waste if the review application is approved. The following items should be included:

- ° A paragraph describing the modifications in the waste management practices usually used at the generation site;
- ° Identification of the proposed carrier and receiver of the reviewed waste;
- ° Comprehensive evaluation of the selected disposal site as it relates to the following:
 - licence from MOE and authorization by the receiver to dispose of the waste at his site;
 - impact of additional waste on the operation of the waste disposal site and on the sewage treatment plant receiving the site leachate;
 - impact on air emission of fugitive dust at the landfill site;
 - leachate control program including leachate collection system or contingency plan (if applicable);
 - sensitivity of ecosystems which could potentially be affected by reviewed waste.

4.0 HOW TO COMPLETE THE REVIEW APPLICATION FORMS

Before attempting to complete the review application forms, it is important that the applicant be familiar with the requirements and procedures of the review process, as detailed in the first three chapters of this manual.

Each numbered section in the application forms must be completed. Sections of the forms which do not apply to your specific application must be marked not applicable (NA).

Additional space is required to complete most of the sections, please attach additional sheets/documents at the end of the application forms as required; identify and reference these documents as Appendices (A to Z) in the application forms.

Please submit the completed review application to:

Hazardous Waste Listing Unit
Waste Management Branch, Area "M"
Ontario Ministry of the Environment
135 St. Clair Avenue West
Toronto, Ontario
M4V 1P5

4.1 Part A: General Information

(See Figure 2)

Item A-1

A Generator Registration Number is issued by the MOE, after the applicant has submitted a Generator Registration Report (Regulation 309). The number is specific not only to the industry but also to the site where the hazardous waste is generated.

If the applicant does not have a Generator Registration Number for the specific site, the first step is to submit a Generator Registration Report to the Waste Management Branch for characterization and registration of the waste. (Forms are available at the Waste Management Branch, or at regional offices of MOE).

FIGURE 2: REVIEW APPLICATION FORM - PART A

**APPLICATION FORM
FOR THE REVIEW OF WASTES
LISTED IN REGULATION 309**
Ontario Ministry of the Environment

INSTRUCTIONS:

1. Please do not complete the attached application form until you have reviewed the Guidance Manual for Hazardous Waste categorization & review program.
2. Each numbered section in the application form must be completed. If information requested is not clear, refer to the Guidance Manual for Review of Wastes. Sections which do not apply to your specific application must be marked not applicable (NA).
3. Additional space is required to complete most of the sections; please attach additional sheets/documents at the end of the application form as required; identify and reference these documents as Appendices (A to Z) in the application form.

4. Please submit the completed review application to :

Hazardous Waste Listing Unit
Waste Management Branch, Area "M"
Ontario Ministry of the Environment
135 St. Clair Avenue West
Toronto, Ontario.
M4V 1P5

(Rev. 040880)

(Rev. 040880)

PART A: GENERATOR IDENTIFICATION

- 1.
- 2.
- 3.

Generator Registration Number
Initial Review Application
Revision/Update

Name of Generator (corporate name, principal)

- 4.
- 5.
- 6.

Name
Address
Municipality
Prov.
Postal Code

Waste Generation Site:

- 7.
- 8.
- 9.

Site Name
Address
Municipality
Prov.
Postal Code

Names of contact (for clarification or for additional information) (Please print)

- 10.

Name
Position/Company
Telephone

Description of waste to be considered for review

(Refer to your MOE registration)

Waste Class (as registered by MOE)

Certification of Accuracy and Responsibility

I certify that I have personally examined and am familiar with the information submitted in this document, and that based on my inquiries, I confirm that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information. I consent to public disclosure of the information submitted as part of this application.

- 13.
- 14.

Name of Company Official
Signature
Position
Date

Item A-2

The applicant should check this box if it is the first review application presented to the MOE. In this case, a new file will be opened for the applicant. Any additional information (submitted afterwards) will be included in this file.

Item A-3

The applicant should check this box if the information submitted is a revision or update of the initial review application.

Items A-4, A-5 and A-6

The name of the company owning the site, plus the complete mailing address of the head office must be indicated here.

Items A-7, A-8, and A-9

The location where the waste is generated should be identified here. Each generation site must be registered separately with the MOE. A site has been specifically defined and means one property or several contiguous properties, owned or leased by the generator, where passage from one property to the next may involve crossing, but not traveling along, a public highway. Item 9 refers to the local municipality (i.e. city, town, village or township) and not to a post office location, county or regional municipality.

Item A-10

The name(s), title(s) and telephone number(s) of the contact persons should be here. These persons should be familiar with the process of waste generation and management. Some of them should be able to answer technical questions relating to the review application, while others should be able to represent company policies or arrange meetings. The names and titles should be printed clearly.

Item A-11

A brief description of the waste submitted for review is entered here. A suitable description would be one similar to the one mentioned in the letter of acknowledgement from MOE during the generator registration process. More details on the

waste generating process is required later in Part B of these forms.

Item A-12

The applicant should include here the waste class number indicated in the MOE letter of acknowledgement of waste registration.

Item A-13 and A-14

A company official who can act on behalf of the company must sign the report. Consultants or others who are not employees of the company cannot sign. The official's name and position (printed characters) and dated signature must be included. One of the contact persons identified in Item 10 may also be the company official signing the report.

4.2 Part B: Manufacturing Processes

The small boxes on the right-hand side of the form must be either checked off (to indicate that information is provided in Appendices) or be completed with NA (Not Applicable). (See Figure 3)

Item B-1

The applicant is required to give a description of the manufacturing processes related to the generation of waste subject to review. The lines

FIGURE 3: REVIEW APPLICATION FORM - PART B

PART B: MANUFACTURING PROCESSES

Description of the manufacturing processes
(including: production lines, operation cycle, surface preparation
and diagrams). (Include additional information in Appendices)

Assessment of Hazardousness

Select one : Approach A

Approach B

Special Procedures

(Fill in box by check or NA)

APPROACH A:

(Include additional information in Appendices)

Material Inventory

Material present in waste stream

Material not in waste stream

Other considerations

Test results of representative samples

Number of samples

Specific hazardous constituents

Waste characteristics

LEP test

Total concentration of constituents (Sch.4)

TOC

Total oil/grease

APPROACH B:

(Include additional information in Appendices)

Review of constituents of Appendix C

Test results of representative samples

Number of samples

Specific hazardous constituents

Other Appendix C constituents

Hazardous characteristics

LEP test

TOC

Total oil/grease

SPECIAL PROCEDURES: Petroleum Refining wastes
(Include additional information in Appendices)

Test results of representative samples

Number of samples

Waste characteristics

LEP test

TOC

Total oil/grease

LEP/EP test

Constituent of special industry

Chromatographic scanning of organics

Additional significant toxic constituents

SPECIAL PROCEDURES: wastes from Multiple Waste Treatment Facilities
(Include additional information in Appendices)

Generator prescreening and waste identification

Test results of representative samples

Number of samples

Waste characteristics

LEP test

TOC

Total oil and grease

Cyanide (total, free, leachable)

Long term stability (if applicable)

Other Appendix C constituents

Statistics on waste types received

Quality Control/Monitoring program

available in the application should be used to identify where, in any attached Appendices, the information can be found. Section 3.1.1 of this manual outlines the detailed requirements.

Item B-2

The applicant has to make a selection at this stage regarding the approach to be used in the identification of the constituents in the waste. Approach A relies on a material inventory to assess the nature of the waste. Approach B relies on a comprehensive sampling and analysis program of the waste. For certain types of industries, (eg. petroleum refining or multi-waste industries), the Special Procedures approach is required.

Section 3.1.2 of this manual provides more information on Approaches A and B.

Sections 3.1.3 and 3.1.4 explain in detail the Special Procedures for petroleum refinery and multiple component industries.

The applicant should check one of the three boxes, indicating a selection, and should complete the selected section only. The two other sections are completed as NA (not applicable).

APPROACH A

Note: If approach A is selected, the applicant must provide a detailed inventory of the chemical used in the process, and explain his selection of constituents for analysis. This information should be included in appendices.

Item B-3

As detailed in Section 3.1.2 of this manual, paragraph A1, a material inventory should be prepared and attached as an appendix to the application forms.

Item B-4

A detailed listing of the constituents present in the waste should be included in the appendix (refer to paragraph A2, Section 3.1.2).

Item B-5

Constituents identified in Item 3 and not included in the waste should also be listed in the appendix (refer to paragraph A3, Section 3.1.2).

Item B-6

Other considerations should be addressed regarding the likelihood that other types of waste may be produced in the process (refer to paragraph A4, Section 3.1.2).

Item B-7

The number of samples is determined from the development of a representative sampling program. Section 3.2.3.1 of this manual reviews the criteria of a representative sample.

For record keeping, the number of samples taken, and results of which are presented in appendices, should be provided in this box.

Item B-8

The analytical results for the specific hazardous constituents for which the waste was listed originally should be presented in appendices. The constituents to be considered are included in Appendix III of this manual.

To determine the specific constituents for which a waste stream was listed in Schedule 1 (Regulation 309), the applicant may want to review the rationale for the listing with the listing/review staff of the Waste Management Branch. This information is not available in Regulation 309.

Item B-9

For each sample, the hazardous waste characteristics (see Appendix I) should be addressed in appendices.

Item B-10

The Leachate Extraction Procedure (LEP) test results should be presented in appendices. The LEP is detailed in Regulation 309.

Any variations in the procedure used from the LEP should be indicated with the results. The reasons

for and the effects on the results should be discussed in appendices.

Item B-11

The total concentrations of the contaminants indicated in Schedule 4 (Regulation 309) should be indicated in appendices.

Item B-12

The results of the total organic carbon (TOC) tests should be included also in appendices.

Item B-13

The results for total oil and grease should be presented in appendices.

APPROACH B

Item B-14

The applicant must provide a review of the constituents of Appendix III of this manual and explain the selection of constituents for analysis. This information should be included in appendices.

Item B-15

The number of samples is determined from the development of a representative sampling program. Section 3.2.3.1 of this manual reviews the criteria of a representative sample.

For record keeping, the number of samples taken, and the analytical results of which are presented in appendices, should be indicated in this box.

Item B-16

The analytical results of specific hazardous constituents for which the waste was listed (i.e., constituents listed in Appendix III of this manual) should be presented in appendices.

To determine the specific listed constituents from a waste stream identified in Schedule 1, the applicant may want to review the rationale of the listing with the listing/review staff of the Waste Management Branch. This information is not available in Regulation 309.

Item B-17

The applicant should provide in appendices the results of analysis for constituents identified in Item 14, and which are part of Appendix C of this manual.

Item B-18

The hazardous waste characteristics (see Appendix A) should be addressed in appendices. An explanation of why the waste does not exhibit a particular characteristic may be provided, in lieu of testing for that characteristic.

Item B-19

Test results of the Leachate Extraction Procedure (LEP) should be presented in appendices. The LEP is detailed in Regulation 309.

Any variations in the procedure used from the LEP should be indicated in the application. Reasons for variations and possible effects on the results should be addressed also.

Item B-20

The results of the Total Organic Carbon (TOC) test should be included in appendices.

Item B-21

The results of the test for total oil and grease should also be presented in appendices.

SPECIAL PROCEDURES: Petroleum Refinery

Note: If these Special Procedures have been selected, the applicant must complete Items 22 to 30 inclusive. Section 3.1.3 of this manual reviews the requirements.

Item B-22

The number of samples is determined from the development of a representative sampling program. Section 3.2.3.1 of this manual reviews the criteria of a representative sample.

For record keeping, the number of samples taken, the analytical results of which are presented in appendices, should be indicated in this box.

Item B-23

The hazardous waste characteristics (i.e., ignitability, corrosivity, reactivity and leachate toxicity, PCB's contamination and pathologic waste) should be addressed in appendices. An explanation of why the waste does not exhibit a particular characteristic may be provided, in lieu of testing for that characteristic.

Item B-24

The results of the Leachate Extraction Procedure (LEP) should be presented in appendices. The LEP is detailed in Regulation 309. Depending on the results of the total oil/grease test, (Item 26), this test can be done at the same time as the extraction procedure for oily waste (Item 27).

Item B-25

The results of the Total Organic Carbon (TOC) test should be included in appendices.

Item B-26

The results of the test for total oil and grease should also be presented in appendices.

Item B-27

If the results of the test for total oil/grease (Item 26) is above one per cent, the Extraction Procedure (EP) for oily waste (Appendix II) will be conducted with the LEP test and results submitted in appendices.

Item B-28

For each of the samples, the total concentration of constituents listed in Table 1 of this manual (Section 3.1.3) should be presented in appendices. Some of these constituents already have been included in the tests for leachate toxic metals.

Item B-29

A chromatographic scanning for organics and identification of important peaks should be carried out and the results presented in appendices.

Item B-30

The applicant should make an assessment of the potential for any additional significant toxic constituents that may be present in the waste. Considerations such as start-up and shut down operations, maintenance, spills, leaks and other accidents should be included in appendices.

SPECIAL PROCEDURES: Multiple Wastes Treatment

Note: If these Special Procedures have been selected, the applicant should complete Items 31 to 41 inclusive. Section 3.1.4 of this manual reviews the requirements.

Item B-31

Due to the nature of the waste generation, the procedures used in the prescreening of the generators or carriers shipping the material/waste to the facilities should be included in appendices. The procedures for identification and classification of the wastes received should also be included.

Item B-32

The number of samples is determined from the development of a representative sampling program. Section 3.2.3.1 of this manual reviews the criteria of a representative sample. For record keeping, the number of samples taken, (the analytical results of which are presented in appendices) should be indicated in this box.

Item B-33

The hazardous waste characteristics (i.e., ignitability, corrosivity, reactivity and leachate toxicity, PCB's contamination and pathologic waste) should be addressed in appendices. An explanation of why the waste does not exhibit a particular characteristic may be provided, in lieu of testing for that characteristic.

Item B-34

The results of the Leachate Extraction Procedure (LEP) should be presented in appendices. The LEP is detailed in Regulation 309.

Item B-35

The results of the Total Organic Carbon (TOC) test should be included in appendices.

Item B-36

The results of the tests for total oil and grease should be presented in appendices.

Item B-37

All forms of cyanide should be analyzed in the samples, including total free cyanides. Leachable cyanide should be analyzed under the LEP test (Item B-34).

Item B-38

If the treatment residues have been stabilized and/or solidified by any process, the long-term stability of the product is very crucial. Description of the testing protocols and results of the test should be presented in appendices.

Item B-39

Test results for all constituents which are reasonably expected to be present in the treatment residues should be presented in appendices. The rationale for not testing for certain constituents must be included.

Item B-40

Statistics on the types of wastes received over a 12 month period should be related to the types of wastes sampled and tested for this review application. The statistics should include the type of waste, the quantity and the source of the materials/wastes.

Item B-41

The quality control and monitoring program is related to the characterization of the treatment residues that need to be disposed of. The program will identify parameters such as frequency of sampling, sampling procedures, selection of contaminants to be listed, testing methods and decision making on waste disposal practices.

This program should be developed and reviewed with the assistance of the Waste Management Branch (MOE).

4.3 Part C: Waste Stream

Note: Section 3.2 of this manual provides additional information about the requirements for waste stream description. (See Figure 4).

Item C-1

The applicant should provide a description of the waste stream in appendices. The description of the stream should be tied in with the description of the manufacturing process (Item 1, Part A of the review forms). The description should provide enough information to MOE to fully understand the waste generating process.

Item C-2

The Waste Class (MOE number) and the Product Identification Number (PIN) as required by the Transportation of Dangerous Goods Act (TDGA), should be included in the individual boxes.

Item C-3

The physical state of the waste (ie. solid, liquid, or gas) and the percentage of solid of the waste should be included here.

FIGURE 4: REVIEW APPLICATION FORM - PART C

PART C : WASTE STREAM

1. Waste stream description (Include additional information in Appendices)

2. Waste Class PIN (TDGA)

3. Physical State % Solid

4. Amount generated

	Average (units)	Maximum (units)
Monthly		
Yearly		

Waste Sampling Program (Include additional information in Appendices) (Fill in box by check or NA)

5. Rationale of representative sampling

6. Time variability

7. Space variability

8. Description of sampling equipment

9. Description of sampling techniques

10. Sample handling/documentation

Waste analytical methods

11. Four hazardous waste characteristics

12. Constituents

13. QA/QC

PART D : WASTE MANAGEMENT PRACTICES

Description of waste management practices
(include additional information in Appendices)

1. Present waste management

2. Planned waste management for reviewed waste

Item C-4

The amount of waste generated should be identified in the respective boxes. The monthly average should be derived from the estimated annual generation. Maximum monthly generation should be derived from the maximum generation, in any 30 day period of the year. Metric units should also be specified for each figure.

Item C-5

In the description of the waste sampling program, (attached in appendices) the applicant should present the rationale used in the development of a representative sampling. As outlined in Section 3.2.3 of this manual, this rationale should be based in part on considerations of how the waste generating process itself varies.

Item C-6

The applicant should address the question of representative sample when the nature or the concentration of the waste may vary in time. (Refer to this manual, Section 3.2.3.1).

Item C-7

The questions of possible variation in the nature of the waste and the concentration of the contaminants should be addressed if the waste is accumulated at one location (i.e. drums, tank lagoon, piles) before sampling and disposing (Section 3.2.3.1).

Item C-8

The sampling equipment should be described in terms of standard sampling equipment (see Section 3.2.3.2); any variations from the standard equipment must be indicated.

Item C-9

The sampling techniques should be described in detail, indicating preparation of equipment, sampling operations with related equipment and sample transfer from sampler to sample containers (see Section 3.2.3.3).

Item C-10

A brief description of the sample handling between the sample collection operation and the laboratory testing operation should be included in appendices. Sample documentation and codes should also be provided (see Section 3.2.3.4).

Item C-11

A brief description of the analytical methods used in the testing for hazardous characteristics should be included in appendices (see Section 3.2.4.1).

Item C-12

A brief description of the analytical methods used in the testing of certain additional constituents should be included in appendices (e.g. cyanide, metals, total oil and grease, TOC, and representative organics) (see Section 3.2.4.2).

Item C-13

A detailed description of the Quality Assurance and Quality Control (QA/QC) should be included in appendices. (see Section 3.2.2).

4.4 Part D: Waste Management Practices

Item D-1

The applicant should describe how the waste is presently managed. (Refer to Section 3.3.).

Item D-2

The applicant must also describe the plan for disposal of the waste, if the reviewing application is approved. (Refer to Section 3.3.).

APPENDIX I

Hazardous Waste Definitions

Section 1, (27) of Regulation 309 defines Hazardous Waste as a waste that is:

- i) Hazardous Industrial Waste (Schedule 1)
- ii) Acute Hazardous Waste Chemical (Schedule 2, Part A)
- iii) Hazardous Waste Chemical (Schedule 2, Part B)
- iv) Severely Toxic Waste (Schedule 3)
- v) Ignitable Waste
- vi) Corrosive Waste
- vii) Reactive Waste
- viii) Radioactive Waste
- ix) Pathological Waste
- x) Leachate Toxic Waste
- xi) PCB Waste as defined in Ontario Regulation 11/82

The first four types of wastes have been identified based on toxicity and hazardousness of typical industrial wastes streams and individual contaminants, and are listed in Schedule 1, 2 and 3. The remaining waste types are defined by their hazardous characteristics, as detailed in the following paragraphs.

Ignitable Waste

Wastes that are Ignitable, as defined in Regulation 309 by any of the following four criteria, are Hazardous:

1. It is a liquid, other than an aqueous solution containing less than 24 per cent alcohol by volume, and has a flash point less than 61°C as determined by any of the following test methods:

ASTM D-56-79,
ASTM D-3243-77,
ASTM D-3278-78,
ASTM D-93-79

Examples of Ignitable liquid waste include ethanol, var-sol, gasoline, petroleum distillates or paint thinners.

2. It is a solid and is capable, under standard temperature and pressure, of causing fire due to friction, absorption of moisture, or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard.

An example of Ignitable solid waste is magnesium dust.

3. It is an ignitable compressed gas as defined by Class 2, Division 1 of the Federal Transportation of Dangerous Goods Regulation (TDGR, 1985).

Class 2, Division 1 gases are defined as substances that:

- a) have a critical temperature less than 50°C or an absolute vapour pressure greater than 294 kPa at 50°C;
- or
- b) exert an absolute pressure, in the cylinder, packaging tube or tank in which it is contained, greater than 275±1 kPa at 21.1°C or 717±2 kPa at 54.4°C.

and

- (i) are ignitable at normal atmospheric pressure when in a mixture of 13 per cent or less by volume with air,
- or
- (ii) have a flammability range of at least 12.

Examples of Ignitable compressed gasses include methane (natural gas), butane or butane mixtures, and propane.

4. It is an oxidizing substance as defined by Class 5 of the TDGR (1985).

This includes substances such as chlorates, permanganates, and nitrates which readily yield oxygen to stimulate, or contribute to, the combustion of other materials. Substances that contain the bivalent -O-O- structure are also considered to be oxidizers.

Corrosive Wastes

Wastes that are Corrosive as defined in Regulation 309 by any of the following two criteria are Hazardous.

1. It is aqueous and has a pH less than or equal to 2.0 or greater than or equal to 12.5.

2. It is liquid and corrodes steel (SAE 1020) at a rate greater than 6.35 millimetres per year at a test temperature of 55°C using the National Association of Corrosion Engineers (NACE) test method TM-01-69.

Reactive Wastes

The Reactive wastes definition presented in Regulation 309 encompasses a number of diverse properties. Generally, the intent is to include wastes that are susceptible to violent/vigorous reactions or are likely to generate toxic fumes. The following criteria are used to define Reactive wastes in Regulation 309.

1. It is normally unstable and readily undergoes violent change without detonating.
2. It reacts violently with water.
3. It forms potentially explosive mixtures with water.
4. When mixed with water it generates toxic gases, vapours or fumes in a quantity sufficient to present danger to human health or the environment.
5. It is a cyanide or sulphide bearing waste which, when exposed to pH conditions between 2.0 and 12.5, can generate toxic gases, vapours or fumes in a quantity sufficient to present danger to human health or the environment.
6. It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement.
7. It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure.
8. It is a Class I explosive as defined by the TDGR.
Schedule II List I of TDGR lists most Class 1 explosives.

Radioactive Waste

At present, there are no radioactive wastes under Ontario jurisdiction. Radioisotope waste may however be disposed of in non-hazardous waste landfills in accordance with the written instruction of the Atomic Energy Control Board.

Pathological Waste

The following definition in Regulation 309 has been developed to identify Pathological waste. The descriptions are for the most part self-explanatory.

Pathological waste means:

- i) any part of the human body, including tissues and bodily fluids, but excluding fluids, extracted teeth, hair, nail clippings and the like, that are not infectious.
- ii) any part of the carcass of an animal infected with a communicable disease or suspected by a licensed veterinary practitioner to be infected with a communicable disease, or
- iii) non-anatomical waste infected with communicable disease.

Leachate Toxic Waste

Wastes that contain the contaminants listed in Schedule 4 of Regulation 309 such that they can leach out in concentrations that exceed 100 times the concentrations shown in the Schedule are Hazardous. The Leachate Extraction Procedure, included as part of Regulation 309, is used to make this determination.

PCB Waste

The legal definition for PCB Wastes is provided in Ontario Regulation 11/82. Wastes that contain PCBs at concentrations greater than 50 parts per million (ppm), by weight, are PCB Wastes. Refer to Regulation 11/82 for further details.

APPENDIX II

Extraction Procedure for Oily Waste

1. Separate the sample (minimum 100 g) into its solid and liquid components. The liquid component is defined as that portion of the sample which passes through a 0.45 um filter media under a pressure differential of 75 psi.
2. Determine the quantity of liquid (mL) and the concentration of the toxicants of concern in the liquid phase (mg/L).
3. Place the solid phase into a Soxhlet extractor, charge the concentration flask with tetrahydrofuran, and extract for 3 hours.
4. Remove the flask containing tetrahydrofuran and replace it with one containing toluene.
5. Extract the solid for a second time, for 3 hours, with the toluene.
6. Combine the tetrahydrofuran and toluene extracts.
7. Analyse the combined extracts for the toxicants of concern.
8. Determine the quantity of liquid (mL) and the concentration of the toxicants of concern in the combined extracts (mg/L).
9. Take the solid material remaining in the Soxhlet thimble and dry it at 100°C for 30 minutes.
10. Run the Leachate Extraction Procedure (Regulation 309) on the solid material.
11. Calculate the mobile metal concentration (MMC) using the following formula:

$$MMC = 1000 ([Q_1 + Q_2 + Q_3]/[L_1 + L_2])$$

Q_1 = Amount (mg) of toxicant in initial liquid phase of sample (amount of liquid X concentration of toxicant)

Q_2 = Amount (mg) of toxicant in combined organic extracts of sample (amount of liquid X concentration of toxicant)

Q_3 = Amount (mg) of toxicant in LEP extract of solid
(amount of extract X concentration of toxicant)

L_1 = Amount of initial liquid (mL)

L_2 = Amount of liquid (mL) in LEP (weight of dried
solid (step 9) X 20)

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D5;GC,0157APP/B

HAZARDOUS CONSTITUENTS*

*(Original listing from 40 CFR 261, App. VIII, 1984)

Acetonitrile (Ethanenitrile)	Arsenic acid (Orthoarsenic acid)
Acetophenone (Ethanone, 1-phenyl)	Arsenic pentoxide (Arsenic (V) oxide)
3-(alpha-Acetylbenzyl)-4-hydroxycoumarin and salts (Warfarin)	Arsenic trioxide (Arsenic (III) oxide)
2-Acetylaminofluorene (Acetamide, N-(9H-fluoren-2-yl)-)	Auramine (Benzenamine, 4,4'-carbonimidoylbis[N,N-Dimethyl-, mono-hydrochloride])
Acetyl chloride (Ethanoyl chloride)	Azaserine (L-Serine, diazoacetate (ester))
1-Acetyl-2-thiourea (Acetamide, N-(aminothioxomethyl)-)	Barium and compounds, N.O.S.*
Acrolein (2-Propenal)	Barium cyanide
Acrylamide (2-Propenamide)	Benz[c]acridine (3,4-Benzacridine)
Acrylonitrile (2-Propenenitrile)	Benz[a]anthracene (1,2-Benzanthracene)
Aflatoxins	Benzene (Cyclohexatriene)
Aldrin (1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a,8b-hexahydro-endo,exo-1,4:5,8-Dimethanonaphthalene)	Benzenearsonic acid (Arsonic acid, phenyl-)
Allyl alcohol (2-Propen-1-ol)	Benzene, dichloromethyl-(Benzal chloride)
Aluminum phosphide	Benzenethiol (Thiophenol)
4-Aminobiphenyl ([1,1'-Biphenyl]-4-amine)	Benzidine ([1,1'-Biphenyl]-4,4'diamine)
6-Amino-1,1a,2,8,8a,8b-hexahydro-8-(hydroxymethyl)-8a-methoxy-5-methyl-carbamate azirino[2',3':3,4]pyrrolo[1,2-a]indole-4,7-dione, (ester) (Mitomycin C)	Benzofluoranthene (2,3-Benzofluoranthene)
(Azirino[2'3':3,4]pyrrolo(1,2-a)indole-4,7-dione, 6-amino-8-(((amino-carbonyl)oxy)methyl)-1,1a,2,8,8a,8b-hexahydro-8a-methoxy-5-methyl-5-(Aminomethyl)-3-isoxazolol (3(2H)-Isoxazolone, 5-(aminomethyl)-) 4-Aminopyridine (4-Pyridinamine)	Benzofluoranthene (7,8-Benzofluoranthene)
Amitrole (1H-1,2,4-Triazol-3-amine)	Benzo[a]pyrene (3,4-Benzopyrene)
Aniline (Benzenamine)	p-Benzoquinone (1,4-Cyclohexadienedione)
Antimony and compounds, N.O.S.*	Benzotrichloride (Benzene, trichloromethyl)
Aramite (Sulfurous acid, 2-chloroethyl-, 2-[4-(1,1-dimethylethyl)phenoxy]-1-methylethyl ester)	Benzyl chloride (Benzene, (chloromethyl)-)
Arsenic and compounds, N.O.S.*	Beryllium and compounds, N.O.S.*
	Bis(2-chloroethoxy)methane (Ethane, 1,1'-[methylenebis(oxy)]bis[2-chloro-])
	Bis(2-chloroethyl) ether (Ethane, 1,1'-oxybis[2-chloro-])
	N,N-Bis(2-chloroethyl)-2-naphthylamine (Chlornaphazine)
	Bis(2-chloroisopropyl) ether (Propane, 2,2'-oxybis[2-chloro-])
	Bis(chloromethyl) ether (Methane, oxybis[chloro-])
	Bis(2-ethylhexyl) phthalate (1,2-Benzenedi-

carboxylic acid, bis(2-ethylhexyl)ester)
 Bromoacetone (2-Propanone, 1-bromo-)
 Bromomethane (Methyl bromide)
 4-Bromophenyl phenyl ether (Benzene, 1-bromo-4-phenoxy-)
 Brucine (Strychnidin-10-one, 2,3-dimethoxy)
 2-Butanone peroxide (Methyl ethyl ketone, peroxide)
 Butyl benzyl phthalate (1,2-Benzenedicarboxylic acid, butyl phenylmethyl ester)
 2-sec-Butyl-4,6-dinitrophenol (DNBP)
 (Phenol, 2,4-dinitro-6-(1-methylpropyl)-)
 Cadmium and compounds, N.O.S.
 Calcium chromate (Chromic acid, calcium salt)
 Calcium cyanide
 Carbon disulfide (Carbon bisulfide)
 Carbon oxyfluoride (Carbonyl fluoride)
 Chloral (Acetaldehyde, trichloro-)
 Chlorambucil (Butanoic acid, 4-[bis(2-chloroethyl)amino]benzene-)
 Chlordane (alpha and gamma isomers) (4,7-Methanoindan, 1,2,4,5,6,7,8,8-octachloro-3,4,7,7a-tetrahydro-) (alpha and gamma isomers)
 Chlorinated benzenes, N.O.S.*
 Chlorinated ethane, N.O.S.*
 Chlorinated fluorocarbons, N.O.S.*
 Chlorinated naphthalene, N.O.S.*
 Chlorinated phenol, N.O.S.*
 Chloroacetaldehyde (Acetaldehyde, chloro-)
 Chloroalkyl ethers, N.O.S.*
 p-Chloroaniline (Benzenamine, 4-chloro-)
 Chlorobenzene (Benzene, chloro-)
 Chlorobenzilate (Benzenecetic acid, 4-chloro-alpha-(4-chlorophenyl)-alpha-hydroxy-, ethyl ester)
 2-Chloro-1, 3-butadiene (chloroprene)
 p-Chloro-m-cresol (Phenol, 4-chloro-3-methyl)
 1-Chloro-2,3-epoxypropane (Oxirane, 2-(chloromethyl)-)
 2-Chloroethyl vinyl ether (Ethene, (2-chloroethoxy)-)

Chloroform (Methane, trichloro-)
 Chloromethane (Methyl chloride)
 Chloromethyl methyl ether (Methane, chloromethoxy-)
 2-Chloronaphthalene (Naphthalene, beta-chloro-)
 2-Chlorophenol (Phenol, o-chloro-)
 1-(o-Chlorophenyl)thiourea (Thiourea, (2-chlorophenyl)-)
 3-Chloropropene (allyl chloride)
 3-Chloropropionitrile (Propanenitrile, 3-chloro-)
 Chromium and compounds, N.O.S.*
 Chrysene (1,2-Benzphenanthrene)
 Citrus red No. 2 (2-Naphthol, 1-[(2,5-dimethoxyphenyl)azo]-)
 Coal tars
 Copper cyanide
 Creosote (Creosote, wood)
 Cresols (Cresylic acid) (Phenol, methyl-)
 Crotonaldehyde (2-Butenal)
 Cyanides (soluble salts and complexes), N.O.S.*
 Cyanogen (Ethanedinitrile)
 Cyanogen bromide (Bromine cyanide)
 Cyanogen chloride (Chlorine cyanide)
 Cycasin (beta-D-Glucopyranoside, (methyl-ONN-azoxy)methyl-)
 2-Cyclohexyl-4,6-dinitrophenol (Phenol, 2-cyclohexyl-4,6-dinitro-)
 Cyclophosphamide (2H-1,3,2,-Oxazaphosphorine, [bis(2-chloroethyl)amino]-tetrahydro-, 2-oxide)
 Daunomycin (5,12-Naphthacenedione, (8S-cis)-8-acetyl-10-[(3-amino-2,3,6-trideoxy)-alpha-L-lyxo-hexopyranosyl]oxy]-7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy-)
 DDD (Dichlorodiphenyldichloroethane)
 (Ethane, 1,1-dichloro-2,2-bis(p-chlorophenyl)-)
 DDE (Ethylene, 1,1-dichloro-2,2-bis(4-chlorophenyl)-)
 DDT (Dichlorodiphenyltrichloroethane)
 (Ethane, 1,1,1-trichloro-2,2-bis(p-chlorophenyl)-)

Diallate (S-(2,3-dichloroallyl) diisopropylthiocarbamate)
 Dibenz[a,h]acridine (1,2,5,6-Dibenzacridine)
 Dibenz[a,j]acridine (1,2,7,8-Dibenzacridine)
 Dibenz[a,h]anthracene (1,2,5,6-Dibenzanthracene)
 7H-Dibenzo[c,g]carbazole (3,4,5,6-Dibenzcarbazole)
 Dibenzo[a,e]pyrene (1,2,4,5-Dibenzpyrene)
 Dibenzo[a,h]pyrene (1,2,5,6-Dibenzpyrene)
 Dibenzo[a,i]pyrene (1,2,7,8-Dibenzpyrene)
 1,2-Dibromo-3-chloropropane (Propane, 1,2-dibromo-3-chloro-)
 1,2-Dibromoethane (Ethylene dibromide)
 Dibromomethane (Methylene bromide)
 Di-n-butyl phthalate (1,2-Benzenedicarboxylic acid, dibutyl ester)
 o-Dichlorobenzene (Benzene, 1,2-dichloro-)
 m-Dichlorobenzene (Benzene, 1,3-dichloro-)
 p-Dichlorobenzene (Benzene, 1,4-dichloro-)
 Dichlorobenzene, N.O.S.* (Benzene, dichloro-, N.O.S.*)
 3,3'-Dichlorobenzidine ([1,1'-Biphenyl]-4,4'-diamine, 3,3'-dichloro-)
 1,4-Dichloro-2-butene (2-Butene, 1,4-dichloro-)
 Dichlorodifluoromethane (Methane, dichlorodifluoro-)
 1,1-Dichloroethane (Ethylidene dichloride)
 1,2-Dichloroethane (Ethylene dichloride)
 trans-1,2-Dichloroethene (1,2-Dichloroethylene)
 Dichloroethylene, N.O.S.* (Ethene, dichloro-, N.O.S.*)
 1,1-Dichloroethylene (Ethene, 1,1-dichloro-)
 Dichloromethane (Methylene chloride)
 2,4-Dichlorophenol (Phenol, 2,4-dichloro-)
 2,6-Dichlorophenol (Phenol, 2,6-dichloro-)
 2,4-Dichlorophenoxyacetic acid (2,4-D), salts and esters (Acetic acid, 2,4-dichlorophenoxy-, salts and esters)
 Dichlorophenylarsine (Phenyl dichloroarsine)
 Dichloropropane, N.O.S.* (Propane, dichloro-, N.O.S.*)

1,2-Dichloropropane (Propylene dichloride)
 Dichloropropanol, N.O.S.* (Propanol, dichloro-, N.O.S.*)
 Dichloropropene, N.O.S.* (Propene, dichloro-, N.O.S.*)
 1,3-Dichloropropene (1-Propene, 1,3-dichloro-)
 Dieldrin (1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octa-hydro-endo,exo-1,4:5,8-Dimethanonaphthalene)
 1,2:3,4-Diepoxybutane(2,2'-Bioxirane)
 Diethylarsine (Arsine, diethyl-)
 N,N-Diethylhydrazine (Hydrazine, 1,2-diethyl-)
 O,O-Diethyl S-methyl ester of phosphorodithioic acid (Phosphorodithioic acid, O,O-diethyl S-methyl ester)
 O,O-Diethylphosphoric acid, O-p-nitrophenyl ester (Phosphoric acid, diethyl p-nitrophenyl ester)
 Diethyl phthalate (1,2-Benzenedicarboxylic acid, diethyl ester)
 O,O-Diethyl O-2-pyrazinyl phosphorothioate (Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester)
 Diethylstilbesterol (4,4'-Stilbenediol, alpha,alpha-diethyl, bis(dihydrogen phosphate, (E)-)
 Dihydrosafrole (Benzene, 1,2-methylenedioxy-4-propyl-)
 3,4-Dihydroxy-alpha-(methylamino)methylbenzyl alcohol (1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-)
 Diisopropylfluorophosphate (DFP) (Phosphorofluoridic acid, bis(1-methylethyl ester)
 Dimethoate (Phosphorodithioic acid, O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] ester)
 3,3'-Dimethoxybenzidine ([1,1'-Biphenyl]-4,4'-diamine, 3-3'-dimethoxy-)
 p-Dimethylaminoazobenzene (Benzenamine, N,N-dimethyl-4-(phenylazo)-)
 7,12-Dimethylbenz[a]anthracene (1,2-Benzanthracene, 7,12-dimethyl-)

- 3,3'-Dimethylbenzidine ([1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethyl-)
 Dimethylcarbamoyl chloride (Carbamoyl chloride, dimethyl-)
 1,1-Dimethylhydrazine (Hydrazine, 1,1-dimethyl-)
 1,2-Dimethylhydrazine (Hydrazine, 1,2-dimethyl-)
 3,3-Dimethyl-1-(methylthio)-2-butanone, O-[(methylamino) carbonyl]oxime (Thio-fanox alpha, alpha-Dimethylphenethylamine (Eth-anamine, 1,1-dimethyl-2-phenyl-)
 2,4-Dimethylphenol (Phenol, 2,4-dimethyl-)
 Dimethyl phthalate (1,2-Benzenedicarboxylic acid, dimethyl ester)
 Dimethyl sulfate (Sulfuric acid, dimethyl ester)
 Dinitrobenzene, N.O.S.* (Benzene, dinitro-, N.O.S.*)
 4,6-Dinitro-o-cresol and salts (Phenol, 2,4-dinitro-6-methyl-, and salts)
 2,4-Dinitrophenol (Phenol, 2,4-dinitro-)
 2,4-Dinitrotoluene (Benzene, 1-methyl-2,4-dinitro-)
 2,6-Dinitrotoluene (Benzene, 1-methyl-2,6-dinitro-)
 Di-n-octyl phthalate (1,2-Benzenedicarboxylic acid, dioctyl ester)
 1,4-Dioxane (1,4-Diethylene oxide)
 Diphenylamine (Benzenamine, N-phenyl-)
 1,2-Diphenylhydrazine (Hydrazine, 1,2-diphenyl-)
 Di-n-propylnitrosamine (N-Nitroso-di-n-propylamine)
 Disulfoton (O,O-diethyl S-[2-(ethylthio)ethyl] phosphorodithioate)
 2,4-Dithioburet (Thioimidodicarbonic diamide)
 Endosulfan (5-Norbornene, 2,3-dimethanol, 1,4,5,6,7,7-hexachloro-, cyclic sulfite)
 Endrin and metabolites (1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-endo,endo-1,4:5,8-dimethanonaphthalene, and metabolites)
 Ethyl carbamate (Urethan) (Carbamic acid, ethyl ester)
 Ethyl cyanide (propanenitrile)
 Ethylenebisdithiocarbamic acid, salts and esters (1,2-Ethanedithiocarbamidithioic acid, salts and esters)
 Ethyleneimine (Aziridine)
 Ethylene oxide (Oxirane)
 Ethylenethiourea (2-Imidazolidinethione)
 Ethyl methacrylate (2-Propenoic acid, 2-methyl-, ethyl ester)
 Ethyl methanesulfonate (Methanesulfonic acid, ethyl ester)
 Fluoranthene (Benzo[j,k]fluorene)
 Fluorine
 2-Fluoroacetamide (Acetamide, 2-fluoro-)
 Fluoroacetic acid, sodium salt (Acetic acid, fluoro-sodium salt)
 Formaldehyde (Methylene oxide)
 Formic acid (Methanoic acid)
 Glycidylaldehyde (1-Propanol-2,3-epoxy)
 Halomethane, N.O.S.*
 Heptachlor (4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-)
 Heptachlor epoxide (alpha, beta, and gamma isomers) (4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-2,3-epoxy-3a,4,7,7-tetrahydro-, alpha, beta, and gamma isomers)
 Hexachlorobenzene (Benzene, hexachloro-)
 Hexachlorobutadiene (1,3-Butadiene, 1,1,2,3,4,4-hexachloro-)
 Hexachlorocyclohexane (all isomers) (Lindane and isomers)
 Hexachlorocyclopentadiene (1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-)
 Hexachloroethane (Ethane, 1,1,1,2,2,2-hexachloro-)
 1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-hexahydro-1,4:5,8-endo,endo-dimethanonaphthalene (Hexachlorohexahydro-endo,endo-dimethanonaphthalene)
 Hexachlorophene (2,2'-Methylenebis(3,4,6-trichlorophenol))

Hexachloropropene (1-Propene, 1,1,2,3,3,3-hexachloro-)
 Hexaethyl tetraphosphate (Tetraphosphoric acid, hexaethyl ester)
 Hydrazine (Diamine)
 Hydrocyanic acid (Hydrogen cyanide)
 Hydrofluoric acid (Hydrogen fluoride)
 Hydrogen sulfide (Sulfur hydride)
 Hydroxymethylarsine oxide (Cacodylic acid)
 Indeno(1,2,3-cd)pyrene (1,10-(1,2-phenylene)pyrene)
 Iodomethane (Methyl iodide)
 Iron dextran (Ferric dextran)
 Isocyanic acid, methyl ester (Methyl isocyanate)
 Isobutyl alcohol (1-Propanol, 2-methyl-)
 Isosafrole (Benzene, 1,2-methylenedioxy-4-allyl-)
 Kepone (Decachlorooctahydro-1,3,4-Methano-2H-cyclobuta[cd]pentalen-2-one)
 Lasiocarpine (2-Butenoic acid, 2-methyl-, 7-[(2,3-dihydroxy-2-(1-methoxyethyl)-3-methyl-1-oxobutoxy)methyl]-2,3,5,7a-tetrahydro-1H-pyrrolizin-1-yl ester)
 Lead and compounds, N.O.S.*
 Lead acetate (Acetic acid, lead salt)
 Lead phosphate (Phosphoric acid, lead salt)
 Lead subacetate (Lead, bis(acetato-O)tetrahydroxytri-)
 Maleic anhydride (2,5-Furandione)
 Maleic hydrazide (1,2-Dihydro-3,6-pyridazine-2,5-dione)
 Malononitrile (Propanedinitrile)
 Melphalan (Alanine, 3-(p-bis(2-chloroethyl)amino)phenyl-, L-)
 Mercury fulminate (Fulminic acid, mercury salt)
 Mercury and compounds, N.O.S.*
 Methacrylonitrile (2-Propenenitrile, 2-methyl-)
 Methanethiol (Thiomethanol)
 Methapyriline (Pyridine, 2-[(2-dimethylamino)ethyl]-2-thenylamino-)

Metholmyl (Acetimidic acid, N-[(methylcarbamoyl)oxy]thio-, methyl ester)
 Methoxychlor (Ethane, 1,1,1-trichloro-2,2'-bis(p-methoxyphenyl)-)
 2-Methylaziridine (1,2-Propylenimine)
 3-Methylcholanthrene
 (Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-)
 Methyl chlorocarbonate (Carbonochloridic acid, methyl ester)
 4,4'-Methylenebis(2-chloroaniline) (Benzeneamine, 4,4'-methylenebis-(2-chloro-))
 Methyl ethyl ketone (MEK) (2-Butanone)
 Methyl hydrazine (Hydrazine, methyl-)
 2-Methylacetonitrile (Propanenitrile, 2-hydroxy-2-methyl-)
 Methyl methacrylate (2-Propenoic acid, 2-methyl-, methyl ester)
 Methyl methanesulfonate (Methanesulfonic acid, methyl ester)
 2-Methyl-2-(methylthio)propionaldehyde-o-(methylcarbonyl) oxime (Propanal, 2-methyl-2-(methylthio)-, [(methylamino)carbonyl]oxime)
 N-Methyl-N'-nitro-N-nitrosoguanidine (Guanidine, N-nitroso-N-methyl-N'-nitro-)
 Methyl parathion (O,O-dimethyl O-(4-nitrophenyl) phosphorothioate)
 Methylthiouracil (4-lH-Pyrimidinone, 2,3-dihydro-6-methyl-2-thioxo-)
 Mustard gas (Sulfide, bis(2-chloroethyl)-) Naphthalene
 1,4-Naphthoquinone (1,4-Naphthalenedione)
 1-Naphthylamine (alpha-Naphthylamine)
 2-Naphthylamine (beta-Naphthylamine)
 1-Naphthyl-2-thiourea (Thiourea, 1-naphthalenyl-)
 Nickel and compounds, N.O.S.*
 Nickel carbonyl (Nickel tetracarbonyl)
 Nickel cyanide (Nickel (II) cyanide)
 Nicotine and salts (Pyridine, (S)-3-(1-methyl-2-pyrrolidinyl)-, and salts)

Nitric oxide (Nitrogen (II) oxide)
 p-Nitroaniline (Benzeneamine, 4-nitro-)
 Nitrobenzine (Benzene, nitro-)
 Nitrogen dioxide (Nitrogen (IV) oxide)
 Nitrogen mustard and hydrochloride salt
 (Ethanamine, 2-chloro-, N-(2-chloroethyl)-
 N-methyl-, and hydrochloride salt)
 Nitrogen mustard N-Oxide and hydrochloride salt
 (Ethanamine, 2-chloro-, N-(2-chloroethyl)-N-methyl-, and hydrochloride salt)
 Nitroglycerine (1,2,3-Propanetriol, trinitrate)
 4-Nitrophenol (Phenol, 4-nitro-)
 4-Nitroquinoline-1-oxide (Quinoline, 4-nitro-1-oxide-)
 Nitrosamine, N.O.S.*
 N-Nitrosodi-n-butylamine (1-Butanamine, N-butyl-N-nitroso-)
 N-Nitrosodiethanolamine (Ethanol, 2,2'-(nitrosoimino)bis-)
 N-Nitrosodiethylamine (Ethanamine, N-ethyl-N-nitroso-)
 N-Nitrosodimethylamine (Dimethylnitrosamine)
 N-Nitroso-N-ethylurea (Carbamide, N-ethyl-N-nitroso-)
 N-Nitrosomethylethylamine (Ethanamine, N-methyl-N-nitroso-)
 N-Nitroso-N-methylurea (Carbamide, N-methyl-N-nitroso-)
 N-Nitroso-N-methylurethane (Carbamic acid, methylnitroso-, ethyl ester)
 N-Nitrosomethylvinylamine (Ethenamine, N-Methyl-N-nitroso-)
 N-Nitrosomorpholine (Morpholine, N-nitroso-)
 N-Nitrosomorpholine (Morpholine, N-nitroso-)
 N-Nitrosomorpholine (Morpholine, N-nitroso-)
 N-Nitrosopiperidine (Pyridine, hexahydro-, N-nitroso-)
 Nitrosopyrrolidine (Pyrrole, tetrahydro-, N-nitroso-)
 N-Nitrososarcosine (Sarcosine, N-Nitroso-)
 5-Nitro-o-toluidine (Benzenamine, 2-methyl-5-nitro-)

Octamethylpyrophosphoramide (Diphosphoramide, octamethyl-)
 Osmium tetroxide (Osmium (VIII) oxide)
 7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid (Endothal)
 Paraldehyde (1,3,5-Trioxane, 2,4,6-trimethyl-)
 Parathion (Phosphorothioic acid, O,O-diethyl O-(p-nitrophenyl) ester)
 Pentachlorobenzene (Benzene, pentachloro-)
 Pentachloroethane (Ethane, pentachloro-)
 Pentachloronitrobenzene (PCNB) (Benzene, pentachloronitro-)
 Pentachlorophenol (Phenol, pentachloro-)
 Phenacetin (Acetamide, N-(4-ethoxyphenyl)-)
 Phenol (Benzene, hydroxy-)
 Phenylenediamine (Benzenediamine)
 Phenylmercury acetate (Mercury, acetatophenyl-)
 N-Phenylthiourea (Thiourea, phenyl-)
 Phosgene (Carbonyl chloride)
 Phosphine (Hydrogen phosphide)
 Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester (Phorate)
 Phosphorothioic acid, O,O-dimethyl O-[p-((dimethylamino)sulfonyl)phenyl] ester (Famphur)
 Phthalic acid esters, N.O.S.* (Benzene, 1,2-dicarboxylic acid, esters, N.O.S.*)
 Phthalic anhydride (1,2-Benzenedicarboxylic acid anhydride)
 2-Picoline (Pyridine, 2-methyl-)
 Polychlorinated biphenyl, N.O.S.*
 Potassium cyanide
 Potassium silver cyanide (Argentate(1-), di-cyano-, potassium)
 Pronamide (3,5-Dichloro-N-(1,1-dimethyl-2-propynyl)benzamide)
 1,3-Propane sultone (1,2-Oxathiolane, 2,2-dioxide)
 n-Propylamine (1-Propanamine)
 Propylthiouracil (Undecamethylenediamine, N,N'-bis(2-chlorobenzyl)-, dihydrochloride)
 2-Propyn-1-ol (Propargyl alcohol)

- Pyridine
- Reserpine (Yohimban-16-carboxylic acid,
11,17-dimethoxy-18-[(3,4,5-
trimethoxybenzoyl)oxy]-, methyl ester)
- Resorcinol (1,3-Benzenediol)
- Saccharin and salts (1,2-Benzoisothiazolin-3-one, 1,1-dioxide, and salts)
- Safrrole (Benzene, 1,2-methylenedioxy-4-allyl-)
- Selenious acid (Selenium dioxide)
- Selenium and compounds, N.O.S.*
- Selenium sulfide (Sulfur selenide)
- Selenourea (Carbamimidoseleonic acid)
- Silver and compounds, N.O.S.*
- Silver cyanide
- Sodium cyanide
- Streptozotocin (D-Glucopyranose, 2-deoxy-2-(3-methyl-3-nitrosoureido)-)
- Strontium sulfide
- Strychnine and salts (Strychnidin-10-one, and salts)
- 1,2,4,5-Tetrachlorobenzene (Benzene, 1,2,4,5-tetrachloro-)
- 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) (Dibenzo-p-dioxin, 2,3,7,8-tetrachloro-)
- Tetrachloroethane, N.O.S.* (Ethane, tetrachloro-, N.O.S.*)
- 1,1,1,2-Tetrachlorethane (Ethane, 1,1,1,2-tetrachloro-)
- 1,1,2,2-Tetrachlorethane (Ethane, 1,1,2,2-tetrachloro-)
- Tetrachloroethane (Ethene, 1,1,2,2-tetrachloro)
- Tetrachloromethane (Carbon tetrachloride)
- 2,3,4,6,-Tetrachlorophenol (Phenol, 2,3,4,6-tetrachloro-)
- Tetraethyldithiopyrophosphate (Dithiopyrophosphoric acid, tetraethyl-ester)
- Tetraethyl lead (Plumbane, tetraethyl-)
- Tetraethylpyrophosphate (Pyrophosphoric acid, tetraethyl ester)
- Tetranitromethane (Methane, tetranitro-)
- Thallium and compounds, N.O.S.*
- Thallic oxide(Thallium (III) oxide)
- Thallium (I) acetate (Acetic acid, thallium (I) salt)
- Thallium (I) carbonate (Carbonic acid, dithallium (I) salt)
- Thallium (I) chloride
- Thallium (I) nitrate (Nitric acid, thallium (I) salt)
- Thallium selenite
- Thallium (I) sulfate (Sulfuric acid, thallium (I) salt)
- Thioacetamide (Ethanethioamide)
- Thiosemicarbazide (Hydrazinecarbothioamide)
- Thiourea (Carbamide thio-)
- Thiuram (Bis(dimethylthiocarbamoyl) di-sulfide)
- Toluene (Benzene, methyl-)
- Toluenediamine (Diaminotoluene)
- o-Toluidine hydrochloride (Benzenamine, 2-methyl-, hydrochloride)
- Tolylene diisocyanate (Benzene, 1,3-diisocyanatomethyl-)
- Toxaphene (Camphene, octachloro-)
- Tribromomethane (Bromoform)
- 1,2,4-Trichlorobenzene (Benzene, 1,2,4-trichloro-)
- 1,1,1-Trichloroethane (Methyl chloroform)
- 1,1,2-Trichloroethane (Ethane, 1,1,2-trichloro-)
- Trichloroethene (Trichloroethylene)
- Trichloromethanethiol (Methanethiol, trichloro-)
- Trichloromonofluoromethane (Methane, trichlorofluoro-)
- 2,4,5-Trichlorophenol (Phenol, 2,4,5-trichloro-)
- 2,4,6-Trichlorophenol (Phenol, 2,4,6-trichloro-)
- 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T) (Acetic acid, 2,4,5-trichlorophenoxy-)
- 2,4,5-Trichlorophenoxypropionic acid (2,4,5-TP) (Silvex) (Propionic acid, 2-(2,4,5-trichlorophenoxy)-)
- Trichloropropane, N.O.S.* (Propane, trichloro-, N.O.S.*)
- 1,2,3-Trichloropropane (Propane, 1,2,3-trichloro-)

O,O,O-Triethyl phosphorothioate (Phosphorothioic acid, O,O,O-triethyl ester)
sym-Trinitrobenzene (Benzene, 1,3,5-trinitro-)
Tris(1-aziridinyl) phosphine sulfide (Phosphine sulfide, tris(1-aziridinyl)-)
Tris(2,3-dibromopropyl) phosphate (1-Propanol, 2,3-dibromo-, phosphate)
Trypan blue (2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'-dimethyl(1,1'-biphenyl)-4,4'-diyl)bis(azo)]bis(5-amino-4-hydroxy-, tetrasodium salt)
Uracil mustard (Uracil 5-[bis(2-chloroethyl)amino]-)
Vanadic acid, ammonium salt (ammonium vanadate)
Vanadium pentoxide (Vanadium (V) oxide)
Vinyl chloride (Ethene, chloro-)
Zinc cyanide
Zinc phosphide

*The abbreviation N.O.S. (not otherwise specified) indicates that those members of the general class are not specifically listed by name in this appendix.

0157APP/C

APPENDIX IV

REGULATION 11/82
PCB WASTE MANAGEMENT

[4M]

WASTE MANAGEMENT—PCBs REGULATION
(O. Reg. 11/82)

Amendments.—O. Reg. 575/84; filed September 7/84, gazetted Sept. 29/84.

1. In this Regulation,

- (a) "hold" includes own, possess and have care or control of and "holder" has a similar meaning;
- (b) "PCB" means any monochlorinated or polychlorinated biphenyl or any mixture of them or any mixture that contains one or more of them;
- (c) "PCB equipment" means equipment designed or manufactured to operate with PCB liquid or to which PCB liquid was added or drums and other containers used for the storage of PCB liquid;
- (d) "PCB liquid" means,
 - (i) liquids, other than liquids used or proposed for use for road oiling, containing PCBs at a concentration of more than fifty parts per million by weight,
 - (ii) liquids used or proposed for use for road oiling, containing PCBs at a concentration of more than five parts per million by weight, and
 - (iii) liquids made contrary to section 6 by diluting liquids referred to in subclause (i) or (ii);
- (e) "PCB materials" means materials containing PCBs at a concentration of more than fifty parts per million by weight whether the material is liquid or not;
- (f) "PCB waste" means,
 - (i) PCB equipment,
 - (ii) PCB liquid, or
 - (iii) PCB material,but does not include,
 - (iv) PCB material or PCB equipment after it has been decontaminated pursuant to guidelines issued by the

[4M-1]

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Ministry of the Environment or instructions issued by the Director,

- (v) PCB equipment that is,
 - (A) an electrical capacitor that has never contained over one kilogram of PCBs,
 - (B) electrical, heat transfer or hydraulic equipment or a vapour diffusion pump that is being put to the use for which it was originally designed or is being stored for such use by a person who uses such equipment for the purpose for which it was originally designed, or
 - (C) machinery or equipment referred to in sub-subclause (vi)(A), or
- (vi) PCB liquid that,
 - (A) is at the site of fixed machinery or equipment, the operation of which is intended to destroy the chemical structure of PCBs by using the PCBs as a source of fuel or chlorine for purposes other than the destruction of PBBs or other wastes and with respect to which a certificate of approval has been issued under section 8 of the Act after the 1st day of January, 1981 specifying the manner in which PCB liquid be processed in the machinery or equipment, or
 - (B) is in PCB equipment referred to in sub-subclause (v)(B).

[O. Reg. 575/84, s. 1] [4M-1]

2. PCB waste is designated as a waste.

[4M-2]

3.—(1) Every site containing PCB waste and PCB related waste but not containing other wastes is classified as a PCB waste disposal site.

(2) In subsection (1), "PCB related waste" means waste containing low levels of PCBs or waste arising from a spill or clean up of PCB liquid or PCB waste.

[O. Reg. 575/84, s. 2.] [4M-3]

4.—(1) Every operator of a waste disposal site shall keep records of all PCB waste held by him after the date this Regulation comes into force.

- (2) The records referred to in subsection (1) shall include,
 - (a) the methods and times at which the PCB waste is received and delivered to and from the site; and
 - (b) where PCB waste is transported to and from the site, the

a. 5(2)(b)(ii) WASTE MANAGEMENT—PCBS REGULATION

[4M·5]

location from or to which it is transported and the person by whom it is transported,

with respect to any delivery, receipt or transport of PCB waste after the date this Regulation comes into force, and

- (c) a description of the nature and quantities of the PCB waste;
- (d) the location of the waste disposal site; and
- (e) the methods of storage of the PCB waste,

with respect to all PCB wastes at the waste disposal site.

(3) Every operator of a waste disposal site shall report to the Director the information required to be recorded under subsection (2),

- (a) by telephone immediately, and in writing within three days, after a PCB waste first comes on the site; and
- (b) in writing within thirty days after any other PCB waste is taken to or from the site.

(4) A record of a PCB waste transfer submitted to the Ministry under Regulation 313 of Revised Regulations of Ontario, 1980 satisfies the requirements of clauses (2)(b), (c) and (d) with respect to the PCB waste referred to in that record.

(5) Two years after an operator of a waste disposal site gives written notice to the Director that he has ceased to be a holder of PCB waste, he may dispose of records kept under subsection (1).

(6) Subsection (1) does not apply in respect of PCB waste that has been finally disposed of by burial before the 1st day of January, 1981. [4M·4]

5.—(1) A PCB waste disposal site is exempt from the provisions of sections 27, 39 and 40 of the Act.

(2) The exemption set out in subsection (1) is subject to the condition that,

- (a) the operator of the site reports to the Director the information required to be recorded under subsection 4(2);
- (b) the operator of the site does not remove or permit to be removed,
 - (i) PCB waste containing over fifty litres of PCB liquid except in accordance with the written instructions of the Director,
 - (ii) any other PCB waste except,
 - (A) in accordance with written instructions of the Director, or
 - (B) to a waste management system or waste disposal site for which a certificate of approval has been

[4M-5]

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issued after the 1st day of January, 1981 containing terms specifying the manner in which PCB waste may be stored, handled, treated, collected, transported, processed or disposed of;

- (c) where there is any PCB liquid in electrical equipment or other container on the site, the operator of the site not remove the liquid from the container except,

(i) to transfer liquid from a leaking container upon notifying the Director of the transfer, or

(ii) pursuant to instructions of the Director; and

- (d) no certificate of approval or provisional certificate of approval has been issued with respect to the site after the 1st day of January, 1981, specifying the manner in which PCB waste may be stored, handled, treated, collected, transported, processed or disposed of.

(3) In respect of a PCB waste disposal site that is offered for sale or lease or the possession of which is otherwise offered, the exemption set out in subsection (1) is subject to the conditions that,

- (a) the person offering to sell, lease or otherwise give possession notifies, in writing,

(i) the prospective purchaser, tenant or person taking possession, of the existence of the site and the requirements, in law, concerning the site, and

(ii) the Director, of the sale, lease or change in possession; and

- (b) where a sale, lease or change of possession occurs, the purchaser, tenant or person taking possession notifies, in writing, the Director, within ten days after the sale, lease or change of possession, of,

(i) the location of the site, and

(ii) the nature and quantity of PCB waste.

[O. Reg. 575/84, s. 3.] [4M-5]

6. No person shall dispose of, decontaminate or otherwise manage PCB waste or dilute PCB waste that is in the form of a liquid except,

- (a) in or to a waste management system operating under a certificate of approval issued after the 1st day of January, 1981 containing terms specifying the manner in which PCB waste may be stored, handled, treated, collected, transported, processed, diluted or disposed of; or

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WASTE MANAGEMENT—PCBs REGULATION

[4M·8]

(b) in accordance with written instructions of the Director.

[O. Reg. 575/84, s. 4] [4M·6]

7. Every person storing PCB waste shall ensure that the PCB waste is in a safe and secure location so as to prevent PCB waste coming into contact with any person and so that any liquid containing PCBs that may escape can be readily recovered and will not discharge, directly or indirectly, into a watercourse or groundwater. [4M·7]

8. No person shall have at a waste disposal site PCB wastes received by the person after this Regulation comes into force unless,

- (a) the PCB waste was delivered to the waste disposal site under written instructions of the Director; or
- (b) the waste disposal site is operated under a certificate of approval containing a condition referring to this section and specifying the circumstances under which PCB waste may be accepted at the waste disposal site. [4M·8]

APPENDIX V

WASTE REVIEW APPLICATION FORM

**APPLICATION FORM
FOR THE REVIEW OF WASTES
LISTED IN REGULATION 309
Ontario Ministry of the Environment**

INSTRUCTIONS:

1. Please do not complete the attached application form until you have reviewed the Guidance Manual for Hazardous Waste categorization & review program.
2. Each numbered section in the application form must be completed. If information requested is not clear, refer to the Guidance Manual for Review of Wastes. Sections which do not apply to your specific application must be marked not applicable (NA).
3. Additional space is required to complete most of the sections; please attach additional sheets/documents at the end of the application form as required; identify and reference these documents as Appendices (A to Z) in the application form.
4. Please submit the completed review application to :

Hazardous Waste Listing Unit
Waste Management Branch, Area "M"
Ontario Ministry of the Environment
135 St.Clair Avenue West
Toronto, Ontario.
M4V 1P5

(Rev.040689)

PART A: GENERATOR IDENTIFICATION

1. Generator Registration Number
2. Initial Review Application ☐
3. Revision/Update ☐

Name of Generator (corporate name, principal)

4. Name
5. Address Prov.
6. Municipality Postal Code

Waste Generation Site:

7. Site Name
8. Address Prov.
9. Municipality Postal Code

10. Names of contact (for clarification or for additional information) (Please print)

Name	Position/Company	Telephone

11. Description of waste to be considered for review (Refer to your MOE registration)

12. Waste Class (as registered by MOE)

Certification of Accuracy and Responsibility

I certify that I have personally examined and am familiar with the information submitted in this document, and that based on my inquiries, I confirm that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information. I consent to public disclosure of the information submitted as part of this application.

13. Name of Company Official Position
14. Signature Date

PART B: MANUFACTURING PROCESSES

1. **Description of the manufacturing processes**
(including: production lines, operation cycle, surface preparation and diagrams). (Include additional information in Appendices)

Assessment of Hazardousness

(Fill in box by check or NA)

2. Select one : Approach A _____ ☐
Approach B _____ ☐
Special Procedures _____ ☐

APPROACH A: (Include additional information in Appendices)

3. Material inventory _____ ☐
4. Material present in waste stream _____ ☐
5. Material not in waste stream _____ ☐
6. Other considerations _____ ☐

Test results of representative samples

7. Number of samples _____ ☐
8. Specific hazardous constituents _____ ☐
9. Waste characteristics _____ ☐
10. LEP test _____ ☐
11. Total concentration of constituents (Sch.4) _____ ☐
12. TOC _____ ☐
13. Total oil/grease _____ ☐

APPROACH B: (Include additional information in Appendices)

14. Review of constituents of Appendix C _____ ☐

Test results of representative samples

15. Number of samples _____ ☐
16. Specific hazardous constituents _____ ☐
17. Other Appendix C constituents _____ ☐
18. Hazardous characteristics _____ ☐
19. LEP test _____ ☐
20. TOC _____ ☐
21. Total oil/grease _____ ☐

SPECIAL PROCEDURES: Petroleum Refining wastes

(Include additional information in Appendices)

Test results of representative samples

(Fill in box by check or NA)

22. Number of samples _____ ☐
23. Waste characteristics _____ ☐
24. LEP test _____ ☐
25. TOC _____ ☐
26. Total oil/grease _____ ☐
27. LEP/EP test _____ ☐
28. Constituent of special industry _____ ☐
29. Chromatographic scanning of organics _____ ☐
30. Additional significant toxic constituents _____ ☐

SPECIAL PROCEDURES: wastes from Multiple Waste Treatment Facilities

(Include additional information in Appendices)

(Fill in box by check or NA)

31. Generator prescreening and waste identification _____ ☐
- Test results of representative samples**
32. Number of samples _____ ☐
33. Waste characteristics _____ ☐
34. LEP test _____ ☐
35. TOC _____ ☐
36. Total oil and grease _____ ☐
37. Cyanide (total, free, leachable) _____ ☐
38. Long term stability (if applicable) _____ ☐
39. Other Appendix C constituents _____ ☐
40. Statistics on waste types received _____ ☐
41. Quality Control/Monitoring program _____ ☐

PART C : WASTE STREAM

1. Waste stream description (Include additional information in Appendices)

2. Waste Class
3. Physical State

- PIN (TDGA)
% Solid

4. Amount generated Average (units) Maximum (units)
- Monthly

- Yearly

Waste Sampling Program (Include additional information in Appendices) (Fill in box by check or NA)

5. Rationale of representative sampling

--
6. Time variability

--
7. Space variability

--
8. Description of sampling equipment

--
9. Description of sampling techniques

--
10. Sample handling/documentation

--

Waste analytical methods

11. Four hazardous waste characteristics

--
12. Constituents

--
13. QA/QC

--

PART D : WASTE MANAGEMENT PRACTICES

Description of waste management practices
(include additional information in Appendices)

1. Present waste management

--
2. Planned waste management for reviewed waste

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